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VISUAL ACUITY OF SELECTEES AND ARMY INDUCTEES[1]

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UNDER the provisions of the Mobilization Regulations (MR-1-9), the visual acuity of each selectee is to be tested upon induction into the Armed Forces. The standard Snellen chart and procedures are used for testing visual acuity, and the readings in Snellen notations (in "twenty" system) are recorded by the induction stations on the individual "Report of Physical Examination and Induction" (D.S.S. Form 221) made out for each selectee.[2] Copies of these individual reports on all selectees rejected by the induction stations and on all Army inductees are received and processed by

[1] From the Medical Statistics Division, Surgeon General's Office, Army Service Forces.

[2] According to regulations, each eye is to be examined separately, without glasses, by covering the other eye with a card (not with the hand). The individual is directed to read the test types from the top of the chart down as far as he can see, and his visual acuity is recorded for each eye, with the distance of 20 feet as the numerator of a fraction and the size of the type of the lowest line he can read correctly as the denominator. If he reads the 20-foot type correctly, his vision is normal and recorded 20/20; if he does not read below the 30-foot type, the vision is imperfect and recorded 20/30; etc. (See Mobilization Regulations 1-9, Section 12, par. 15.)

The Surgeon General's Office, Army Service Forces. The presented findings on visual acuity are based on data from these processed reports.

BASIC DATA

Date and selection of data. The data relate to February, 1943. The reports (D.S.S. Form 221) used in the analysis were obtained by means of a random sample from the total number of forms received on selectees examined at the Joint Army and Navy induction stations during that month.

The sample comprised a total of 23,706 individual forms distributed in the following manner by race: white selectees—21,139 forms; colored selectees—2,567 forms.

Limitations of data. Certain limitations accompany the data and it seems desirable for proper orientation to point these out at the very outset.

1. The data refer only to examinations conducted at the induction stations. Consequently, the findings reported here do not include selectees rejected by the local boards. However, the proportion of selectees rejected by the local boards because of eye defects was negligible,[3] while the visual acuity of those rejected by the local boards because of other than eye defects may be assumed to be the same as that of the selectees sent to the induction stations. Therefore, the exclusion of these rejectees should not have affected significantly the findings.

2. Not all selectees were tested at the induction stations for vision. Until recently, a practice has prevailed at certain induction stations of not giving a physical examination to selectees rejected for mental deficiency and illiteracy. Here again, the assumption is made that the visual acuity of those rejectees who were not given a physical examination is essentially the same as that of the other selectees, and their exclusion should not have altered appreciably the findings.

3. The Surgeon General's Office receives reports on Army inductees only. With the establishment in February, 1943, of the Joint Army and Navy induction stations, the Navy (including Marine Corps and Coast Guard) began procuring men through the Selective Service Sys-

[3] About 2 out of 1,000 white selectees and about 3 out of 1,000 colored selectees were rejected by the local boards because of vision, which includes eye diseases as well as visual defects.

tem (instead of recruiting volunteers) on a pro-rata basis fixed monthly.[4] No copies of the forms on Navy inductees are sent to The Surgeon General of the Army. In order to present a complete picture on the visual acuity of all selectees, an adjustment was made to include the Navy inductees.[5]

Scope of analysis. The tabulated data deal only with *uncorrected* vision—a further fact that somewhat restricts the findings since the visual requirements for service in the Armed Forces are to a great extent expressed in terms of corrected vision.[6] The basic data are presented in four main tables (Tables 1-4).

PRESENTED TABULATIONS

Explanation of distribution. Each of the main tables (Tables 1-4) is divided into three sections dealing with separate age groups. Each section presents cross-tabulations of 1,000 individuals of a particular age group by visual acuity of the right and left eye. For instance, the section in Table 1 dealing with white selectees aged 18 to 24 shows that out of 1,000 such selectees examined in February, 1943, 624 selectees had a visual acuity of 20/20 in the right and left eye (left upper corner of the table), 8 selectees had a visual acuity of 20/30 in the right eye and 20/40 in the left eye (third row and second column of that table), etc. The section dealing with white selectees aged 25 and over shows 506 out of 1,000 such selectees having 20/20 in each eye and 12 having 20/30 and 20/40 in the right and left eye, respectively, etc. The column labeled "Total" in each of the sections shows the distribution of the respective selectees by the visual acuity of the left eye alone, and the row labeled "Total" shows the corresponding distribution by visual acuity of the right eye alone. Thus, each particular cell of these tabulations (except those under "Total") indicates the number

[4] The white inductees who qualified for general service in February, 1943, were to be distributed between the Army and the Navy on the basis of 4.4: 1.0, and those of the colored inductees on the basis of 10.3: 1.0.

[5] The adjustment consisted merely in raising the number of Army inductees within the visual acuity range of 20/70 and 20/25 (the Navy's visual requirement in February, 1943) by the factor 5.4/4.4 for white, and by 11.30/10.30 for colored.

[6] Although the Snellen readings are recorded on the D.S.S. Form 221 separately for uncorrected and corrected vision, for the present the data on corrected vision were not available. A tabulation which will include all data on both uncorrected and corrected vision is contemplated for the near future.

TABLE 1

ACUITY OF VISION OF WHITE SELECTEES FEBRUARY, 1943

(DISTRIBUTION OF 1,000 WHITE SELECTEES, BY ACUITY OF VISION)

AGE: 18 TO 24

LEFT EYE (Snellen notations)	RIGHT EYE: 20/20	20/30	20/40	20/50	20/70	20/100	20/200	20/201 or less	Blind	Total
20/20	624	38	7	3	3	3	5	3	1	687
20/30	28	97	9	2	3	2	2	1		144
20/40	6	8	16	2	2	1	1	1		39
20/50	2	3	2	7	2	1	1			18
20/70	3	3	2	3	9	3	1	1		25
20/100	3	2	1	2	4	15	2	1		30
20/200	4	1	1	1	1	3	20	2		33
20/201 or less	3	1	1		1		2	15		23
Blind	1									1
Total	674	153	41	20	25	28	34	24	1	1000

AGE 25 AND OVER

LEFT EYE (Snellen notations)	RIGHT EYE: 20/20	20/30	20/40	20/50	20/70	20/100	20/200	20/201 or less	Blind	Total
20/20	506	45	15	2	3	2	3	9	2	587
20/30	34	124	13	3	5	2	2	3	1	187
20/40	8	12	34	6	3	2	1	1		67
20/50	2	4	4	9	2	1	1			23
20/70	4	4	3	3	10	4	2	1		31
20/100	3	2	1	1	4	13	5	1		30
20/200	4	2	1	1	1	3	23	2		37
20/201 or less	4	2	1	1	1	1	1	23		34
Blind	3	1								4
Total	568	196	72	26	29	28	38	40	3	1000

ALL AGES

LEFT EYE (Snellen notations)	RIGHT EYE: 20/20	20/30	20/40	20/50	20/70	20/100	20/200	20/201 or less	Blind	Total
20/20	594	40	9	3	3	3	4	5	2	663
20/30	30	103	11	2	3	2	2	2		155
20/40	6	9	22	3	2	2	1	1		46
20/50	2	3	3	7	2	1	1			19
20/70	3	3	2	3	10	3	2	1		27
20/100	3	2	1	2	4	13	3	1		29
20/200	4	2	1	1	1	3	20	2		34
20/201 or less	4	1	1		1	1	2	16		26
Blind	1									1
Total	647	163	50	21	26	28	35	28	2	1000

ARMY SERVICE FORCES, OFFICE OF THE SURGEON GENERAL, MEDICAL STATISTICS DIVISION, STATISTICAL ANALYSIS BRANCH, 17 OCTOBER 1943

TABLE 2

ACUITY OF VISION OF COLORED SELECTEES
FEBRUARY, 1943

(DISTRIBUTION OF 1,000 COLORED SELECTEES, BY ACUITY OF VISION)

AGE: 18 TO 24

LEFT EYE \ RIGHT EYE (Snellen notations)	20/20	20/30	20/40	20/50	20/70	20/100	20/200	20/201 or less	Blind	Total
20/20	690	39	5	1	1	1	5	4	2	748
20/30	18	109	9	1	2	2	2	2		145
20/40	7	8	22	1	2	1	2	1		44
20/50	2		1	2	2	1	1			9
20/70	2	1	3	1	5	1	1			14
20/100	1	2	1			5	2	1		12
20/200	2	1	1	1		1	8	1		15
20/201 or less	3	2	1		1		1	2		10
Blind	3									3
Total	728	162	43	7	13	12	22	11	2	1000

AGE 25 AND OVER

LEFT EYE \ RIGHT EYE (Snellen notations)	20/20	20/30	20/40	20/50	20/70	20/100	20/200	20/201 or less	Blind	Total
20/20	594	43	9	3	3		4	4	3	663
20/30	28	148	10	1	3	1	4	1	1	197
20/40	5	3	38	4	1					51
20/50			4	5	5	1			1	16
20/70		3	3	3	8	3				20
20/100	3	1	3		1	4	1			13
20/200		3			1	4	8		3	19
20/201 or less	6	4	1	1	1			1		14
Blind	6					1				7
Total	642	205	68	17	23	14	17	6	8	1000

ALL AGES

LEFT EYE \ RIGHT EYE (Snellen notations)	20/20	20/30	20/40	20/50	20/70	20/100	20/200	20/201 or less	Blind	Total
20/20	662	41	6	1	1	1	4	4	2	722
20/30	21	122	9	1	2	2	2	1	1	161
20/40	7	6	28	2	2	1	1	1		48
20/50	1		2	3	3	1				10
20/70	1	1	3	2	6	1	1			15
20/100	1	1	1			6	1	1		11
20/200	2	1	1	1	1	2	9		1	18
20/201 or less	4	2	1	1	1			2		11
Blind	4									4
Total	703	174	51	11	16	14	18	9	4	1000

ARMY SERVICE FORCES, OFFICE OF THE SURGEON GENERAL
MEDICAL STATISTICS DIVISION, STATISTICAL ANALYSIS BRANCH
12 NOVEMBER 1943

TABLE 3

ACUITY OF VISION OF WHITE ARMY INDUCTEES FEBRUARY, 1943

(DISTRIBUTION OF 1,000 WHITE ARMY INDUCTEES, BY ACUITY OF VISION)

AGE: 18 TO 24

LEFT EYE \ RIGHT EYE (SNELLEN NOTATIONS)	20/20	20/30	20/40	20/50	20/70	20/100	20/200	20/201 OR LESS	BLIND	TOTAL
20/20	623	36	7	2	3	3	5	3	1	683
20/30	27	94	8	2	3	2	2	1		139
20/40	5	7	19	2	3	1	1	1		39
20/50	2	3	3	8	3	1	1			21
20/70	3	3	2	3	12	3	2			28
20/100	3	2	1	2	4	18	2	1		33
20/200	4	2	1	1	1	3	23	2		37
20/201 OR LESS	3	1			1		1	13		19
BLIND	1									1
TOTAL	671	148	41	20	30	31	37	21	1	1000

AGE: 25 AND OVER

LEFT EYE \ RIGHT EYE (SNELLEN NOTATIONS)	20/20	20/30	20/40	20/50	20/70	20/100	20/200	20/201 OR LESS	BLIND	TOTAL
20/20	518	45	14	1	3	2	5	8	2	598
20/30	34	111	12	3	4	3	2	3		172
20/40	8	11	36	7	3	2	1	1		69
20/50	2	5	6	8	3	1	1			26
20/70	4	5	3	5	11	5	2			35
20/100	4	1	1	2	4	12	8			32
20/200	4	3	1	1	1	3	25	1		39
20/201 OR LESS	4	1	1	1	1	1	1	16		26
BLIND	2	1								3
TOTAL	580	183	74	28	30	29	45	29	2	1000

ALL AGES

LEFT EYE \ RIGHT EYE (SNELLEN NOTATIONS)	20/20	20/30	20/40	20/50	20/70	20/100	20/200	20/201 OR LESS	BLIND	TOTAL
20/20	601	38	8	2	3	3	5	4	1	665
20/30	28	98	9	2	3	2	2	2		146
20/40	5	8	22	3	3	2	1	1		45
20/50	2	3	3	9	3	1	1			22
20/70	3	3	2	4	13	3	2			30
20/100	3	2	1	2	4	17	4			33
20/200	4	2	1	1	1	3	24	1		37
20/201 OR LESS	3	1			1		1	14		20
BLIND	2									2
TOTAL	651	155	46	23	31	31	40	22	1	1000

ARMY SERVICE FORCES, OFFICE OF THE SURGEON GENERAL, MEDICAL STATISTICS DIVISION, STATISTICAL ANALYSIS BRANCH
12 NOVEMBER 1943

TABLE 4

ACUITY OF VISION OF COLORED ARMY INDUCTEES FEBRUARY, 1943

(DISTRIBUTION OF 1,000 COLORED ARMY INDUCTEES, BY ACUITY OF VISION)

AGE: 18 TO 24

		RIGHT EYE									
	SNELLEN NOTATIONS	20/20	20/30	20/40	20/50	20/70	20/100	20/200	20/201 OR LESS	BLIND	TOTAL
LEFT EYE	20/20	726	35	5	1	2	1	5	3		778
	20/30	15	97	9	2	2	2	1			128
	20/40	7	7	20		1	1	1	1		38
	20/50	2		2	2	2	1				9
	20/70	2	1	3	1	5	1				13
	20/100	2	2	1			5	2			12
	20/200	1		1	2		1	11			16
	20/201 OR LESS	2	1					1	1		5
	BLIND	1									1
	TOTAL	758	143	41	8	12	12	21	5		1000

AGE: 25 AND OVER

		RIGHT EYE									
	SNELLEN NOTATIONS	20/20	20/30	20/40	20/50	20/70	20/100	20/200	20/201 OR LESS	BLIND	TOTAL
LEFT EYE	20/20	678	36	11		3			6		734
	20/30	22	126	3	3	3		6			163
	20/40	8		33	3	3					47
	20/50					5	6				11
	20/70		3			8	3				14
	20/100	5						3			8
	20/200						3	3			6
	20/201 OR LESS	3	3	3					2		11
	BLIND	6									6
	TOTAL	722	168	50	6	22	12	12	8		1000

ALL AGES

		RIGHT EYE									
	SNELLEN NOTATIONS	20/20	20/30	20/40	20/50	20/70	20/100	20/200	20/201 OR LESS	BLIND	TOTAL
LEFT EYE	20/20	716	35	6	1	2	1	4	3		768
	20/30	17	104	7	2	2	2	2			136
	20/40	7	6	22	1	1	1	1	1		40
	20/50	2		1	3	2	1				9
	20/70	1	1	2	1	7	1				13
	20/100	2	1	1			5	2			11
	20/200	1		1	1		1	9			13
	20/201 OR LESS	3	2	1				1	1		8
	BLIND	2									2
	TOTAL	751	149	41	9	14	12	19	5		1000

ARMY SERVICE FORCES, OFFICE OF THE SURGEON GENERAL
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18 NOVEMBER 1943

out of 1,000 individuals of the given group with specified vision in the right and left eye. The same explanation applies to the other tables.

While Table 1 supplies information on visual acuity of white selectees by age, Tables 2, 3, and 4 supply corresponding information on colored selectees, white Army inductees, and colored Army inductees, respectively. Three age groups are used: 18-24, 25 and over, and all ages (18 and over).

All basic information on each of the mentioned groups can be obtained directly from the main tables.

Inter-group comparisons. For inter-group comparisons, by race and age, two additional (cumulative) tables (Tables 5 and 6) were derived from the main tables.

The comparisons are expressed in terms of (a) specified vision or better—in *each eye* (Table 5), and (b) specified vision or better—*in at least one eye* (Table 6). Reference to these tables should clarify the meaning of these concepts of visual acuity.

(a) As seen from Table 5, 787 out of 1,000 selectees aged 18 to 24 had vision of 20/30 or better in each eye. It means that these 787 individuals could have had in either eye any visual acuity within range of 20/20 to 20/30, but none of these individuals had a visual acuity of less than 20/30 in either eye. Such distributions are often known as "visual acuity of the poorer eye."

(b) Table 6 shows for the mentioned group, 871 selectees with 20/30 or better in at least one eye. It means that out of 1,000 selectees aged 18 to 24, 871 (or 87.1 percent) had a visual acuity of 20/30 or better in at least one eye, the visual acuity of the other eye being the same or worse than 20/30. These distributions are frequently referred to as "visual acuity of the better eye."

For complete information on the visual acuity of selectees and Army inductees, by race and age, the reader must be referred to the tables, as only certain specific and general findings will be stated here.

SPECIFIC FINDINGS

The specific findings given here are limited to white and colored selectees and Army inductees of all ages. For comparison of imperfect vision, the following three Snellen readings were chosen: 20/40 or better, 20/70 or better, and 20/200 or better. These readings were selected mainly because the requirements for the various services in

TABLE 5

Number of individuals among 1,000 selectees and 1,000 army inductees with specified vision or better in each eye, by race and age, February, 1943 *

SNELLEN READINGS, AND RACE	DISTRIBUTION OF 1,000 SELECTEES AND 1,000 ARMY INDUCTEES OF EACH AGE GROUP BY VISUAL ACUITY IN EACH EYE					
	Selectees, by age			*Army Inductees, by age*		
	18-24	25-39	All ages (18-39)	18-24	25-39	All ages (18-39)
White:						
20/20 or better	624	506	594	623	518	601
20/30 or better	787	709	767	780	708	765
20/40 or better	835	791	824	826	789	817
20/50 or better	856	821	847	848	821	841
20/70 or better	886	858	878	883	862	878
20/100 or better	923	893	914	923	899	918
20/200 or better	966	942	959	971	956	969
20/400 or better	998	993	997	998	995	997
Colored:						
20/20 or better	690	594	662	726	678	716
20/30 or better	856	813	846	873	862	872
20/40 or better	907	878	902	921	917	920
20/50 or better	915	895	912	930	923	930
20/70 or better	934	924	933	949	948	949
20/100 or better	949	941	948	965	962	964
20/200 or better	976	966	974	990	977	986
20/400 or better	995	985	992	999	994	998

* Based on a sample chosen from the individual Reports of Physical Examination and Induction (D.S.S. Form 221) on selectees examined at the Joint Army and Navy Induction Stations during February, 1943.

the Armed Forces have been primarily defined by these levels of visual acuity.

White selectees of all ages. Of the white selectees of all ages, 59.4 percent had normal vision (20/20), 82.4 percent had 20/40 or better, 87.8 percent had 20/70 or better, and 95.9 percent had 20/200 or better—in each eye; 71.6 percent had normal vision, 90.0 had 20/40 or better, 93.9 had 20/70 or better, and 98.4 had 20/200 or better—in at least one eye.

TABLE 6

*Number of individuals among 1,000 selectees and 1,000 army inductees with specified vision or better in at least one eye, by race and age, February 1943**

SNELLEN READINGS, AND RACE	DISTRIBUTION OF 1,000 SELECTEES AND 1,000 ARMY INDUCTEES OF EACH AGE GROUP BY VISUAL ACUITY IN AT LEAST ONE EYE					
	Selectees, by age			*Army Inductees, by age*		
	18-24	25-39	All ages (18-39)	18-24	25-39	All ages (18-39)
White:						
20/20 or better	737	649	716	731	660	715
20/30 or better	871	829	861	861	825	852
20/40 or better	903	886	900	895	887	891
20/50 or better	920	905	917	914	909	912
20/70 or better	940	928	939	937	933	936
20/100 or better	961	951	960	961	957	960
20/200 or better	985	977	984	987	984	986
20/400 or better	1,000	1,000	1,000	1,000	1,000	1,000
Colored:						
20/20 or better	786	711	763	810	778	803
20/30 or better	927	894	914	934	925	932
20/40 or better	963	948	957	965	967	965
20/50 or better	971	964	968	973	978	973
20/70 or better	979	978	978	979	989	981
20/100 or better	988	988	988	987	995	989
20/200 or better	998	999	998	999	998	999
20/400 or better	1,000	1,000	1,000	1,000	1,000	1,000

* Based on a sample chosen from the individual Reports of Physical Examination and Induction (D.S.S. Form 221) on selectees examined at the Joint Army and Navy Induction Stations during February, 1943.

White army inductees of all ages. Of the white Army inductees of all ages, 60.1 percent had normal vision, 81.7 percent had 20/40 or better, 87.8 percent had 20/70 or better, and 96.9 percent had 20/200 or better—in each eye; 71.5 percent had 20/20 or better, 89.1 percent had 20/40 or better, 93.6 had 20/70 or better, and 98.6 percent had 20/200 or better—in at least one eye.

Colored selectees of all ages. Of the colored selectees of all ages, 66.2 percent had normal vision, 90.2 percent had 20/40 or better, 93.3 had 20/70 or better, and 97.4 percent had 20/200 vision or better—in

each eye; 76.3 percent had 20/20 or better, 95.7 percent had 20/40 or better, 97.8 percent had 20/70 or better, and 99.8 percent had 20/200 vision or better—in at least one eye.

Colored army inductees of all ages. Of the colored inductees of all ages, 71.6 percent had normal vision, 92.0 percent had 20/40 or better, 94.9 percent had 20/20 or better, and 98.6 percent had 20/200 or better—in each eye; 80.3 percent had 20/20 or better, 96.5 per cent had 20/40 or better, 98.1 percent had 20/70 or better, and 99.9 percent had 20/200 vision or better—in at least one eye.

GENERAL FINDINGS

Normal vision. Tables 1-4 indicate marked variations by age and race, with respect to the proportion of individuals having normal vision. A larger proportion of individuals with normal vision in each eye was found among the younger age group, from either racial class, than among the older age group. Irrespective of age, proportionately more colored selectees had normal vision in each eye than white selectees.

The differences in normal vision between the white and colored groups show no decrease with age. In fact, the difference between the two racial groups was somewhat larger in the older than in the younger age group, which may suggest that diminution in visual acuity with age is slower among colored than among white. Whether the differences are due to racial (genetic) factors or to occupational or other social factors is a question that must be left open.

Imperfect vision. Tables 5 and 6 indicate that the differences in visual acuity by age and race persist on all levels of vision (especially on the higher levels). These differences by age and race are conspicuously brought out in Figures 1 to 3. It will be noted in Figure 3 that the proportions of colored inductees with specified vision or better in each eye exceeded those of white inductees with specified vision or better in at least one eye. In other words, the colored inductees fared better in their poorer eye than the white inductees in their better eye.

ADDITIONAL INFORMATION

Age of selectees. The relatively small sample did not allow a finer breakdown of the "vision" data by age than that given in the tables. However, since visual acuity varies sharply with age, additional information on the age of the selectees is given.

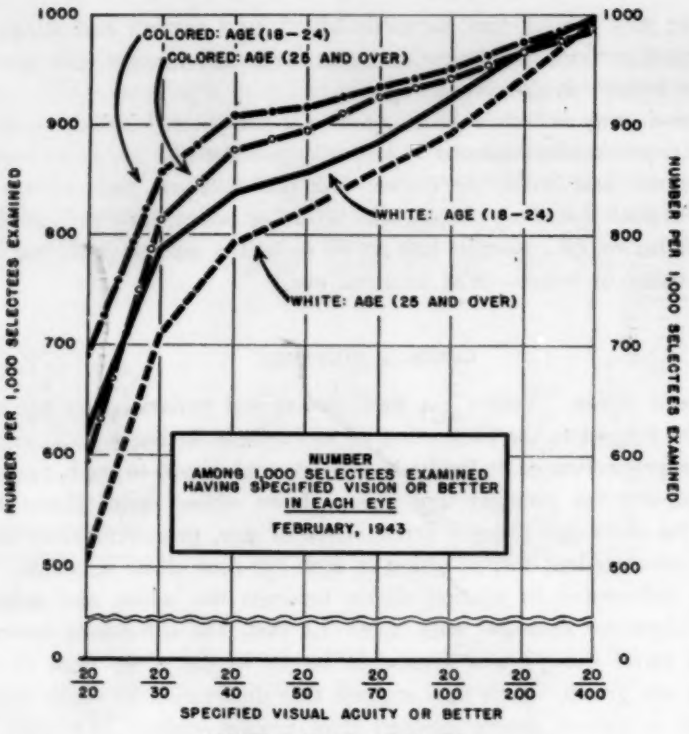

FIGURE 1 (Based on Table X)

ARMY SERVICE FORCES, OFFICE OF THE SURGEON GENERAL MEDICAL STATISTICS DIVISION, STATISTICAL ANALYSIS BRANCH 21 OCT. 1943

The mean age (to nearest birthday) of white selectees aged 18 to 24 was estimated as 19.6 years; that of the 25 and over age group as 30.6 years, and that of all ages (18 and over) as 22.5 years.

The mean age of colored selectees aged 18 to 24 was estimated as 20.1 years; that of the 25 and over age group as 30.6 years, and that of all ages (18 and over) as 23.2 years.

The relatively low mean age of the selectees should be kept well in mind for a proper appraisal of the findings.

Comparison with other findings. Compared with other findings, the present findings indicate somewhat lower visual acuity.[7] This is

[7] See: a study on NYA youth published by the Federal Security Agency ("The Health Status of NYA Youth," 1942); an older study by D. S. Collins and R. H. Britten ("Variations by Eyesight at Different Ages, as Determined by the Snellen Test," Public Health Reports, December, 1924; also a bulletin published by the National Headquarters of the Selective Service Systems ("Analysis of Report of Physical Examinations," Nov., 1941. Medical Statistics Bulletin No. 1), based on reports up to May, 1941.

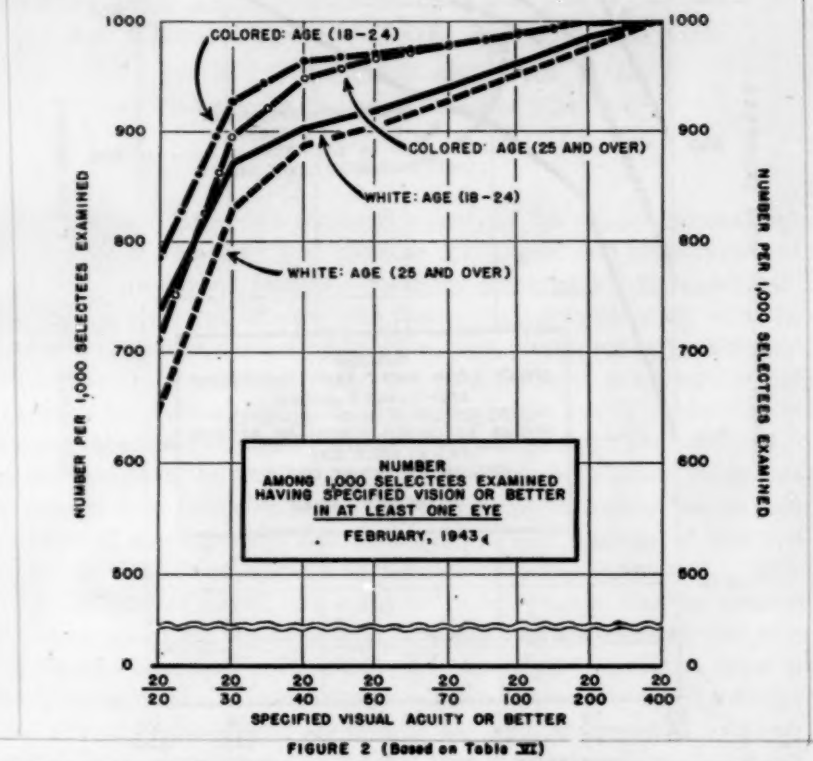

FIGURE 2 (Based on Table XII)

ARMY SERVICE FORCES, OFFICE OF THE SURGEON GENERAL — MEDICAL STATISTICS DIVISION, STATISTICAL ANALYSIS BRANCH 21 OCT. 1943

probably due to the fact that many of the selectees who were previously rejected for vision were reprocessed, increasing thus the proportion of selectees with low visual acuity among those examined in February, 1943.

Future studies should determine whether these findings are characteristic of selectees of this month alone, or whether they generally reflect present prevailing conditions.

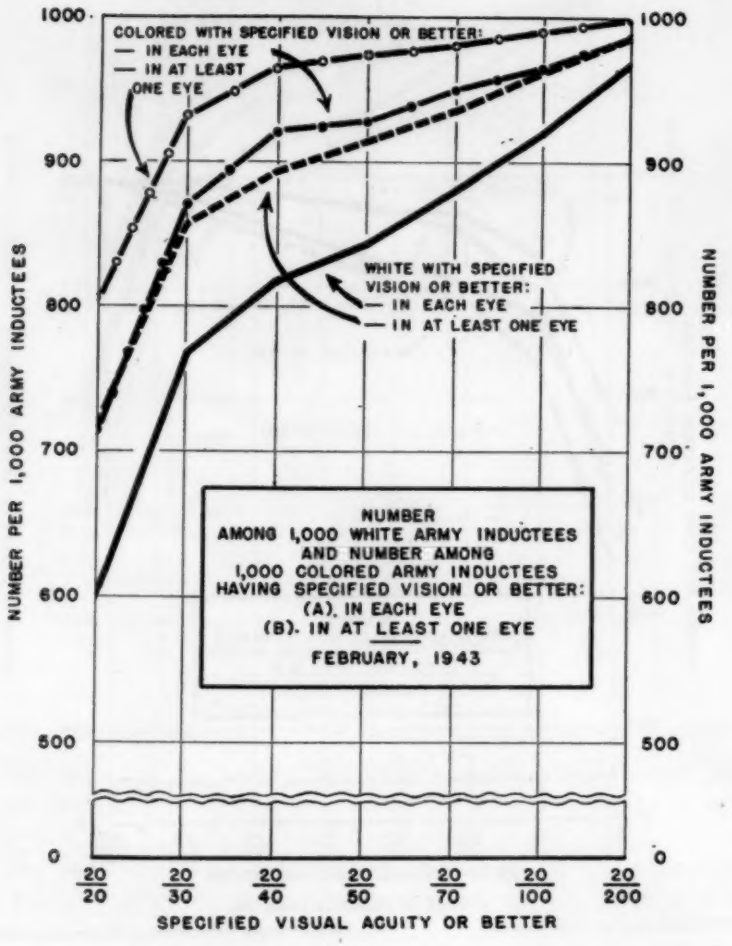

FIGURE 3

[illegible] SERVICE FORCES, OFFICE OF THE SURGEON GENERAL
MEDICAL STATISTICS DIVISION, STATISTICAL ANALYSIS BRANCH, 12 NOV. 1943

PERSONAL APPEARANCE AND NEUROTICISM AS RELATED TO AGE AT MARRIAGE

BY ERNEST W. BURGESS AND PAUL WALLIN

University of Chicago and Stanford University

INTRODUCTION

THIS paper is a report of a study of the relation between age at marriage and physical appearance and neuroticism of males and females. Research on variability in age at marriage has till now been limited largely to the study of social factors such as race, nationality, nativity, class, occupation and education.[1] This research has established the fact of differences in average age at marriage for broad social and economic groups, but is inadequate in accounting for the variability within any given group. The explanation of differences in the marital ages of individuals is, it seems reasonable to assume, to be found rather in the study of psychological factors such as physical attractiveness and personality. The findings of the few studies made of these factors lend plausibility to this assumption.

C. Grillenzoni found, in a study of Italian women, that the average marrying age of the more beautiful ones was 22.7 as compared with 26.0 for the less beautiful.[2] The findings of a study of women students at the University of California was that a few years after leaving college 34.0 percent of those rated as beautiful had wed, whereas only 11.3 percent of those regarded as homely had been married.[3] From this it can be inferred that the attractive girls tended to be married at an earlier age than those of less comely appearance.

Three other studies are less directly relevant but bear mention here. Miss C. F. Gilmore's research on the graduates of the Southwestern

[1] For a review of this research see J. K. Folsom: The Family and Democratic Society. *New York*, 1943, pp. 474-85.

[2] Physical characteristics and dress as demographic factors. (I caratteri del fisico e del vestire come fattori demografici.) *Metron*, Vol. 10, 3, p. 153, 1934.

[3] S. J. Holmes, and C. E. Hatch. Personal appearance as related to scholastic records and marriage selection in college women. HUMAN BIOLOGY, 10: 65-76, 1938.

State Normal School of Pennsylvania indicated that the girls having the highest rating for beauty tended to have the highest marriage rate and that "the marriage rate in general declined in proportion as the grade for beauty was low.[4] This conclusion is in accord with that of a similar investigation by Miss J. O. Naly.[5] These studies are cited here on the assumption that factors associated with the probability of marriage and non-marriage also play a rôle in determining age at marriage.

Finally, reference may be made to a study of college men. R. F. Winch studied the correlates of degree, range, and frequency of courtship behavior which he defined as "a general term to designate opposite-sex-pair-relationships between men of the group studied and women of their acquaintance."[6] This research is regarded as pertinent to the problem being considered here on the premise that there is an appreciable correlation between courtship behavior and marriage age, i, e. that men having more extensive and intensive associations with the opposite sex would marry at a younger age than those involved in fewer such relationships. Of particular interest for this report[7] are Winch's findings of an absence of correlation between the degree[8] of courtship behavior of men and (a) a composite self-rating of the attractiveness of their appearance and (b) their scores on an abridged version of the Thurstone Neurotic Inventory. Winch's conclusion as to the influence of appearance in the mating process is not at variance with those of the studies preceding his, since his findings were for a male population. Data available for the study to be reported here made it possible to test the findings both of previous studies of females and Winch's study of males. In addition data are for the first time presented on the relation of neuroticism to marriage age of females.

The data of this study were collected as part of a larger study of

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[4] S. J. Holmes: The Trend of the Race. *New York*, 1921, p. 228.

[5] Facial Appearance and Other Factors in Mate Selection Among College Graduates. Unpublished M. A. thesis, University of Pittsburg, cited in C. Grillenzoni, *op. cit.*, pp. 121-32.

[6] Social and Personality Characteristics of Courtship Revealed in College Men. Unpublished Ph.D. dissertation, University of Chicago, 1942, p. 9.

[7] The reader is referred to Winch's dissertation for the findings on the relation between courtship behavior and a number of social and psychological variables.

[8] Degree of courtship behavior signifies how far a given relationship has advanced, the maximum point on the degree scale being "marriage" and the minimum, "no dating."

engagement and marriage.[9] One thousand engaged couples filled out eight-page schedules [10] which included a rating of physical appearance and the 42 most discriminating questions in the Thurstone Inventory.[11] Data on age at marriage have been obtained from 483 of these couples who have filled out second schedules after being married three years. These 483 couples are the subjects of this report.

At the time of their participation in the research the thousand couples lived in the Chicago metropolitan region. They were almost entirely in the age range from twenty to thirty. Three fourths of the young men and not quite two thirds of the women were at the college level of education. Most of the remainder were high school graduates. Their parents were predominantly native-born, Protestant, and in the middle and upper-middle class. Most of them were engaged in business or in the professions. Although the findings offered below are based on the 483 couples for whom information on age at marriage was available there is no reason to believe that this group is not representative of the original sample. It is therefore assumed that the socio-economic characterization of the thousand couples is equally applicable to the group on which this study is based.

AGE AT MARRIAGE AND PHYSICAL APPEARANCE

The subjects rated their physical appearance on a five-point scale ranging from "very good looking" to "very plain looking." The distribution of the ratings of the men and women and the average age at marriage for each category are given in Table 1.

It is interesting to note that in the case of both the men and the women the average age at marriage increases as the attractiveness ratings decline. The differences for the men are, however, obviously not significant. The significant differences for the women are between those who

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[9] 1000 Engaged Couples. Unpublished study by the writers.

[10] The schedules were filled out independently by the men and women of the couples. They were given the choice of remaining anonymous or signing their names—(a) if they wished to volunteer for interviews or (b) to facilitate reaching them after marriage.

[11] The questions discriminated best between persons having the lowest and highest scores on the complete test. See L. L. and T. G. Thurstone: A neurotic inventory. *Journal of Social Psychology*, 1: 3-30, 1930.

TABLE 1

Ratings of physical appearance and average age at marriage of 483 men and women

RATINGS OF PHYSICAL APPEARANCE	MEN			WOMEN		
	No.	*Per-cent*	Average age at marriage	*No.*	*Per-cent*	Average age at marriage
Very good looking	6	1.2	25.4 ± 3.2	9	1.9	23.3 ± 2.9
Good looking	134	27.8		205	42.6	
Fairly good looking	262	54.4	25.5 ± 3.5	247	51.4	23.6 ± 2.9
Plain looking	74	15.4	25.8 ± 3.6	19	3.9	25.3 ± 3.3
Very plain looking	6	1.2		1	0.2	
No rating	1			2		
Total	483	100.0		483	100.0	

rate themselves as "plain" or "very plain" and those who rate themselves as "fairly good looking" or higher.[12]

The reliability of the self-ratings as judged by their correlation with repeat ratings made some time after the original ones was .56 and .63 for the men and women respectively.[13]

In order to check on the validity of the relationship found between self-ratings and age at marriage, the ratings made of subjects by their fiancé(e)s [14] and by friends or acquaintances were tested for their relation to the marital age of subjects.[15] The association between the latter two sets of ratings and age at marriage will be reported below. First, however, it is of interest to consider the distribution of ratings obtained from the subjects, their fiancé(e)s and their friends. These are shown in Table 2.

[12] The C. R. of the difference between the "very good looking" and the "good looking" (combined) and the "plain looking" and "very plain looking" (combined) is 2.6. The C. R. of the difference between the latter combination and the "fairly good looking" is 2.3.

[13] The repeat ratings were obtained for 98 men after an average interval of 7.5 months and for 105 women after an average lapse of 6.8 months.

[14] The reliability of these ratings as judged by their correlation with repeat ratings was .65 for the men and .66 for the women.

[15] The ratings of the friends or acquaintances were obtained for only 347 of the couples. Moreover, these ratings were made after the couples had been married approximately 3 years, whereas the self-ratings and the ratings of one another by members of the couples were as of the time of their engagement. The former are, therefore, not strictly comparable with the latter.

TABLE 2

Ratings by physical appearance of men and women subjects by self, fiancé(e) and friend

RATING	MEN SUBJECTS						WOMEN SUBJECTS					
	Self ratings		Fiancées' ratings		Friends' ratings		Self ratings		Fiancés' ratings		Friends' ratings	
	No.	*Per cent*	*No.*	*Per cent*	*No.*	*Per cent*	*No.*	*Per cent*	*No.*	*Per cent*	*No.*	*Per cent*
Very good looking	4	1.1	31	8.9	24	6.9	7	2.0	67	19.2	42	12.1
Good looking	93	26.5	193	55.1	128	36.9	147	42.0	200	57.1	137	39.5
Fairly good looking	192	54.8	117	33.4	130	37.5	183	52.3	76	21.7	121	34.9
Plain looking	57	16.2	9	2.6	52	15.0	12	3.4	7	2.0	43	12.3
Very plain looking	5	1.4	...	...	13	3.7	1	.3	...	...	4	1.2
Total	351	100.0	350	100.0	347	100.0	350	100.0	350	100.0	347	100.0

As can be seen from the table, the distributions differ strikingly. In the case of both men and women there is an obvious tendency for the subjects to rate themselves as less attractive than they are rated by their fiancé(e)s or friends. On the other hand their fiancé(e)s tend to rate them as more attractive than do their friends.[16] It may be that persons are modest in rating themselves, that their fiancé(e)s are extravagant and accordingly that the ratings of friends which are intermediate are closest to an objective evaluation.[17]

Given the marked differences in the distribution of ratings obtained from the three sources, it was not thought likely that they would be consistent in their relation to the marital age of the subjects. It was, therefore, gratifying to find that the ratings made by the fiancé(e)s and friends of the subjects showed a positive association with age at marriage similar to that found for the subjects' self-ratings. Moreover, as indicated by the data of Table 3, the relation appears to hold for the men as well as the women. The ratings showing greatest differences in age at marriage for both sexes are those which the members of the couples

[16] The one exception is that a higher proportion of women are rated as plain and very plain by friends than by self.

[17] Further research is necessary to confirm this interpretation.

TABLE 3

Average marital age of subjects by their fiancé(e)s' and friends' ratings of their appearance

RATING	AVERAGE MARITAL AGE			
	By fiancé(e)s' ratings		By friends' ratings	
	Men	*Women*	*Men*	*Women*
Very good looking	24.5	22.5	25.5	23.3
Good looking	25.3	23.7		
Fairly good looking	26.0	24.0	25.3	23.8
Plain looking, Very plain looking	27.8	25.4	26.5	23.8

made of each other.[18] This is particularly apparent in the age at marriage of the man. Those rated as "very good looking" by their fiancées were married at the age of 24.5 while the men rated less favorably were married at later ages.[19]

Similarly, the women rated as most attractive by their fiancés have also married at an earlier age than those less favorably rated. Thus, those rated as "very good looking" were married at 22.5 as compared with 25.4, the marital age of those rated "plain" or "very plain looking".[20]

The ratings made by their friends or acquaintances are least differentialing with respect to the marital age of the subjects.[21] Nonetheless,

[18] This seems to indicate that personal beauty as a factor in marriage selection is more effective as the person is seen by the other than as he sees himself or as friends see him.

[19] The C. R. of "very good looking" (24.5) with "good looking" (25.3) is 1.7, with "fairly good looking" (26.0) 2.9, with "fairly good looking", "plain" and "very plain looking" combined (26.1) 3.8. The C. R. of "good looking" (25.3) with "fairly good looking" and less combined (26.1) is 2.3.

[20] The C. R. of the difference is 3.8. The C. R. of "very good looking" (22.5) with "good looking" (23.7) is 4.6, with "fairly good looking" (24.0) 4.3.

[21] For the men the C. R. of "very good looking" and "good looking" combined (25.5) with "plain" and "very plain looking" combined (26.5) is 1.7. The C. R. of "plain" and "very plain looking" (26.5) with all categories combined (25.4) is 1.9. For the women, the C. R. of "very good looking" and "good looking" combined (23.3) with "plain" and "very plain looking" combined (23.8) is 1.0. The C. R. of "very good looking" and "good looking" combined (23.3) with all other categories combined (23.8) is 1.5.

with the one exception of the men who are rated "fairly good looking", the friends' ratings of the physical appearance of the subjects are found to be positively associated with their ages at marriage.

AGE AT MARRIAGE AND NEUROTICISM

It seems to the writers a reasonable expectation that differences in scores on the 42 most significant items of the Thurstone Inventory would be associated with variations in age at marriage. A factor analysis of these questions indicated that they involve eight factors.[22] These were tentatively described as cycloid, hypersensitivity, depression, social intraversion, self-consciousness in formal relations, inferiority feelings, cognitive defect and autistic tendency. Persons scoring high on the test might, therefore, be described briefly as having ups and downs in mood, easily hurt, subject to depression, self-conscious in public and shy in intimate relations, lacking in self-confidence and having a tendency to daydream. It might be expected on two grounds that such persons on the average would marry at a later age. First, they would be less attractive and have less appeal for the opposite sex than others not suffering from these inadequacies. Second, they would have greater difficulty in establishing the intimate relationship which is a necessary prelude to marriage.

Our *a priori* expectation was not borne out by the findings. Age at marriage was correlated with total neurotic score and no significant relationship was found for the men or women. The association for the former was .03 ± .05 and for the latter .11 ± .05. Age at marriage was also analyzed for its relation to the neurotic score of the subjects on each of the eight factors of the Inventory, but none of the factors were found to be significant.[23]

The absence of any significant correlation between age at marriage of men and women and either the total scores on the Thurstone Inventory or the scores on its component factors does not, of course, necessarily indicate that age at marriage is not, in part at least, determined by per-

[22] C. I. Mosier: A factor analysis of certain neurotic symptoms. *Psychometrika*, 2: 263-86, 1937.

[23] This analysis was made for the women subjects only. Since the eight factor scores of the women showed no relation to age at marriage, it was assumed that the same would be true of the men in view of the fact that their total scores on the Inventory yielded a lower correlation with age at marriage than was found for the women.

sonality. It more probably suggests that other aspects of personality [24] than those touched on by the Inventory must be taken into account in assessing the influence of personality.

SUMMARY

1. Analysis of data obtained from 483 couples confirmed the conclusion of other studies that there is a positive correlation between physical attractiveness of women and their age at marriage.

2. No association was found between age at marriage and the personal appearance of men as judged by self-ratings. This finding agrees with the one previous investigation relevant for this problem.

3. But an association was found between age at marriage of men and their physical attractiveness, as measured by ratings of fiancées and friends.

4. For women, the differences in age at marriage in relation to ratings of physical attractiveness is greatest by ratings of fiancé, intermediate by self-ratings, and least by friends' ratings. For men, ratings of fiancée are more discriminative than those of friends.

5. No relationship was shown for men or women between age at marriage and neuroticism as measured by total score on the Thurstone Inventory. The finding for the men is in agreement with that of an earlier study.

6. No correlation was found between age at marriage and the neurotic scores of subjects on any of the eight factors to which the 42 items of the Inventory have been reduced.

[24] Such as those studied by Winch, for example.

THE SKELETAL AND DENTAL DEVELOPMENT AND VARIABILITY OF THE GORILLA

(*Concluded*)

BY FRANCIS E. RANDALL

Departments of Anthropology and of Biology, Harvard University

SKELETON *(Without skull)*

INTRODUCTION

The discussion of the skeletal material will be treated in the following manner:

Vertebrae
Sternum
Ribs
Scapulae
Clavicles
Humerus
Radius
Pelvis
Femur
Tibia
Asymmetries and variations
Epiphyseal union

Unfortunately, the skeletal material is not so plentiful as that of the skulls. The numbers in the various age groups are listed below:

	Male	*Unsexed*	*Female*
Stage I	..	4	..
II*	10	..	5
III	10	..	3
IV	11	..	10
V	29	..	11
VI	60	..	36
	130	4	65

Total: 199

* Tentatively sexed.

Many of the young skeletons contained in the collection at Western Reserve were preserved in a wet condition, retaining cartilaginous epiphyses. This made possible X-ray assessments of the epiphyses and also a comparatively accurate measurement of the bones themselves without necessitating rough estimates from dried specimens. The following were available in the wet condition: Three of Stage I; eight of male, Stage II; two of female, Stage II; seven of male, Stage III; two of female, Stage III; five of male, Stage IV; and six of female Stage VI. A very few of Stage V were wet, but this stage has sufficiently far developed that wet preservation is not essential. Because of this wet condition, it is possible that metric values on these bones may be a little higher comparatively than are those of the dry bones in the late two stages, but the error involved is much less than would be the one involved in dry measurements. Ingalls (1927) showed that comparatively little shrinkage occurs when drying long bones.

Skeletal measurement techniques used were those described by Schultz (1930, 1937). Metric values are listed at the end of the section.

Vertebrae

Method: Only two metric values were taken on the vertebrae. These were the corpus breadths of the seventh thoracic and the second lumbar vertebrae. The original intent was to measure the middle of the thoracic column and the middle of the lumbar, but the frequency of 14 thoracic and four lumbar vertebrae made this impractical. Therefore, the seventh thoracic and the second lumbar were always used. The breadth represents the minimum transverse of the corpus.

Discussion: The values are listed in the tables of the appendix, as well as their variabilities when present in sufficient numbers. A percentage table may be of interest.

	Male		*Female*	
	Per cent of Stage VI		Per cent of Stage VI	
	T7	L2	T7	L2
Stage I	59.2	56.2	Included with males	
II*	69.5	73.8	81.0	73.5
III	77.8	82.2	84.7	93.1
IV	91.5	90.9	99.6	96.6
V	100.0	97.8	98.2	95.0
VI	100.0	100.0	100.0	100.0

* Tentatively sexed.

We see here that the same pattern is followed as in the cranial growth. Further discussions will show that the same thing appears in other aspects of skeletal growth, namely, the female reaches her adult size by Stage IV, or very shortly thereafter, while the male lags into Stage V.

Although strictly under the heading of variation, it might be of value to discuss here the numbers of vertebrae occurring in the various regions. This factor has already been discussed by Schultz (1930), but it is of interest to record also the corresponding variations in the present and larger series, even though some of this material has been used before by Schultz.

As Schultz (1930) has stated, there are always seven cervical vertebrae. The only variations encountered are in the remainder of the spinal column and these are listed in the following table.

		Combined ages					
		Male			*Female*		
		Number	Per cent	Mean	Number	Per cent	Mean
Thoracic:	12.0	7	6.4		5	8.1	
	12.5	1	0.9		..	...	
	13.0	90	82.5		53	85.5	
	13.5	1	0.9		..	...	
	14.0	10	9.0	13.0	4	6.4	13.0
		109			62		
Lumbar:	2.0	1	0.9		..	...	
	3.0	32	28.6		21	33.2	
	3.5	2	1.8		..	...	
	4.0	77	68.7	3.7	42	66.8	3.7
		112			63		
Sacral:	5.0	61	54.5		39	63.0	
	6.0	50	44.6		22	35.4	
	7.0	1	0.9	5.5	1	1.6	5.4
		112			62		
Coccygeal:	2.0	9	18.2		1	6.3	
	3.0	18	36.8		7	43.7	
	4.0	21	43.0		7	43.7	
	5.0	1	2.0	3.3	1	6.3	3.5
		49			16		
Total:	31	6	12.5		3	23.0	
	32	19	39.6		5	38.4	
	33	20	41.7		4	30.8	
	34	3	6.2		..	...	
	35	..	...	32.2	1	7.7	32.3
		48			13		

This table shows clearly that there is no sex difference in the number of vertebrae in the different regions or in the total column. The modes of the various regions may be summarized thus: Cervical, 7; Thoracic, 13; Lumbar, about two-thirds, 4 and one-third, 3; Sacral, over one-half, 5 and under one-half, 6; Coccygeal, about evenly split between 3 and 4; and for the Total, between 32 and 33.

So far as age changes are concerned, the only trait which indicates an observable transition is the number of coccygeal vertebrae. It is possible that fusion of the distal members occurs during Stages III and IV, reducing the total. The average proceeds from about 3.7 down to 3.3. This may not be significant because the smallness of numbers limits any further interpretation.

Of developmental variations in the vertebrae the following may here be mentioned:

In twenty-nine cases the seventh cervical vertebra lacked complete transverse foramina on both sides; in eleven cases, the same was true of the sixth cervical vertebra also; in ten cases, the foramen was absent on the right side only and in five cases on the left only. In two cases the sixth cervical vertebra also lacked the left.

Sternum

Methods: The various portions of the manubrium and the corpus represent centers of ossification during the growth process. Five dimensions were observed: length of the manubrium and its breadth; length and breadth of the sternum; and the length of both sternum and manubrium combined. The length of the manubrium is taken by placing the fixed arm of the sliding calipers against the superior margin, tangent to the two processes of the manubrio-clavicular facet, and the movable arm tangent to the inferior margin. The breadth is the maximum, lying at the inferior processes of the manubrio-clavicular facet. The sternum length is maximum from superior to inferior portions of the *bony* segments. This dimension does not include any part related to the xiphoid process. The breadth is the minimum of the first segment. The length of the total is roughly the sum of the two longitudinal dimensions, but was checked by measurement wherever possible. Fusion of all the segments of Stage V and Stage VI facilitates this measurement, but early stages usually had to be added.

Discussion: The segments are very variable in the early stages due to the progressive ossification. Percentage tables follow.

Manubrium length

	Male	*Female*
	Per cent of Stage VI	Per cent of Stage VI
Stage I*	42.6	....
II**	60.1	59.6
III	64.7	68.7
IV	80.6	93.0
V	89.5	96.4
VI	100.0	100.0

* Unsexed.
** Tentatively sexed.

Here again we observe that the female makes a marked jump between Stages III and IV to gain on the male and reach a proportion near the adult form.

Manubrium breadth

	Male	*Female*
	Per cent of Stage VI	Per cent of Stage VI
Stage I*	42.4	....
II**	50.9	59.0
III	58.8	70.6
IV	70.6	89.0
V	88.3	89.1
VI	100.0	100.0

* Unsexed.
** Tentatively sexed.

The breadth of the manubrium shows marked increase in the last interval, indicating that the final deposition of bone does not occur until the full adult stage has been reached.

Corpus length

	Male	*Female*
	Per cent of Stage VI	Per cent of Stage VI
Stage I*	46.0	....
II**	57.8	65.9
III	66.8	80.0
IV	78.5	96.3
V	101.0	104.0
VI	100.0	100.0

* Unsexed.
** Tentatively sexed.

The familiar female exuberance and the male lag is again noticed, but the male reaches its maximum a little earlier than usual.

Corpus breadth

	Male	*Female*
	Per cent of Stage VI	Per cent of Stage VI
Stage I*	46.1	....
II**	59.4	63.1
III	67.8	70.6
IV	76.5	94.0
V	88.8	95.8
VI	100.0	100.0

* Unsexed.
** Tentatively sexed.

Corpus breadth follows the usual pattern.

Sternum length

	Male	*Female*
	Per cent of Stage VI	Per cent of Stage VI
Stage I*	44.2	....
II**	58.5	63.5
III	66.0	74.5
IV	77.0	95.5
V	94.6	100.8
VI	100.0	100.0

* Unsexed.
** Tentatively sexed.

Sternum length, being a total of manubrium and corpus lengths, merely follows the pattern already established by them.

The number of pairs of sternal ribs shows considerable variability, as is evident from the following figures:

	Pairs of ribs	*Male*		*Female*	
		No. cases	*Per cent*	*No. cases*	*Per cent*
Stages II-VI	6	3	4.6	4	12.1
	7	63	93.4	28	84.6
	8	..		1	3.3
Total		66		33	

Figures 2, 3, 4, and 5 show the morphological variations encountered. Further discussion of the ossification will be made under variations and epiphyseal union patterns.

Clavicle

The clavicle is rather difficult to assess in length because the sternal epiphysis is so late in closing. For this reason, the values obtained are not strictly correct. All clavicles of Stages I-IV were measured without epiphyses, while only those with complete epiphyses are listed in Stages V and VI. Part of the increase from Stage IV to V is due to the addition of the closed epiphysis. In any case, the maximum length was obtained.

The percentage growth ratio is again tabulated. Only the left clavicle was measured, so all values are based on bones of the same side.

Left clavicle length

	Male Per cent of Stage VI	*Female* Per cent of Stage VI
Stage I*	48.4	....
II**	58.6	64.2
III	73.7	80.9
IV	86.5	88.2
V	95.0	97.2
VI	100.0	100.0

* Unsexed.
** Tentatively sexed.

The gain of the female over the male in Stage III again occurs, but from that stage on there is only slight divergence.

Scapula

The scapula required some specialized techniques already devised by Schultz. The axis of the spine was prolonged to the medial edge and then the physiological length was measured from the center of the glenoid fossa to the point of intersection of the spinous axis with the medial margin. This distance was then used as a base line upon which perpendiculars were erected to intersect the most superior margin of the superior fossa and the most inferior margin of the angle of the inferior fossa. The lengths of these perpendiculars then served as the breadths of the respective fossae. Thus, three dimensions were obtained, the physiological length, the upper fossa breadth, and the lower fossa breadth. The left scapula was measured whenever possible.

These three dimensions will be discussed separately.

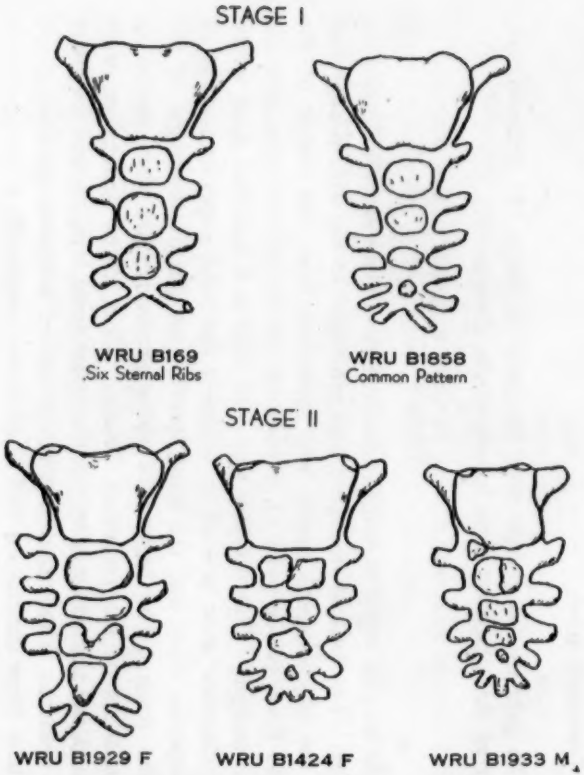


Figure 2. VARIATION IN THE STERNUM

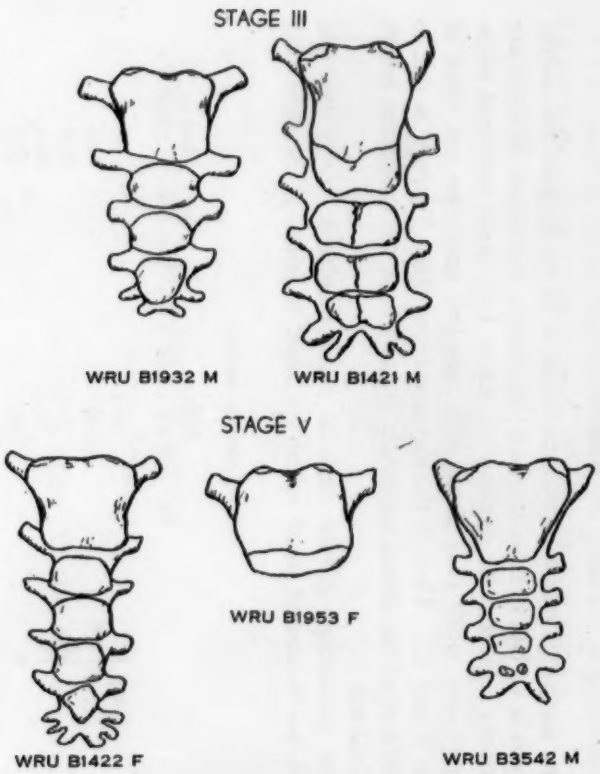
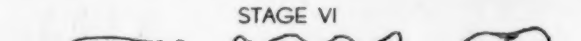
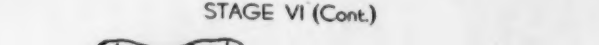
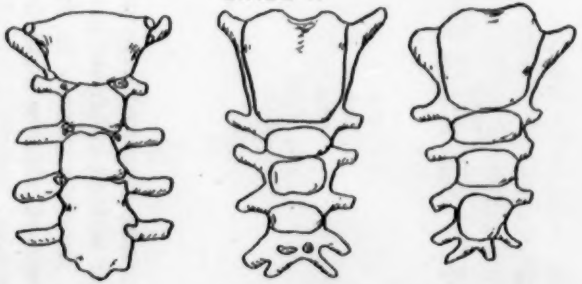


Figure 3. VARIATION IN THE STERNUM



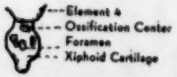


STAGE VI



MCZ 29047 F WRU B3542 F WRU B1999 F

MCZ 23162 M

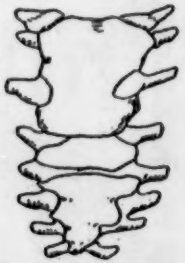


USNM 23272 M

Figure 4. VARIATION IN THE STERNUM

STAGE VI (Cont.)

USNM 22032 M



AMNH 69398 (MAM.) M

Figure 5. VARIATION IN THE STERNUM

Scapula length

	Male Per cent of Stage VI	*Female* Per cent of Stage VI
Stage I*	44.7	....
II**	58.0	63.1
III	66.7	81.4
IV	82.5	96.9
V	96.5	98.4
VI	100.0	100.0

* Unsexed.
** Tentatively sexed.

Breadth of upper fossa

	Male Per cent of Stage VI	*Female* Per cent of Stage VI
Stage I*	37.4	....
II**	56.1	60.8
III	63.4	76.7
IV	76.0	95.3
V	98.9	95.5
VI	100.0	100.0

* Unsexed.
** Tentatively sexed.

Breadth of lower fossa

	Male Per cent of Stage VI	*Female* Per cent of Stage VI
Stage I*	34.7	....
II**	54.8	57.5
III	64.9	69.6
IV	79.0	98.4
V	97.0	98.3
VI	100.0	100.0

* Unsexed.
** Tentatively sexed.

It should be mentioned that the young scapulae measured were wet ones, with the epiphyses preserved. Scapulae without epiphyses were disregarded. There is probably, therefore, some discrepancy in the relative sizes of the young wet bones as compared with the adult dry bones, but this could not be corrected at this time.

The scapular length again shows that the female is considerably ahead of the male. The breadths of the fossae also support this. There is, too, some indication that the physiological length attains its proportions earlier than do the two breadths, or the morphological length, which is a total of the two.

The scapular index, or the ratio of the physiological length to the morphological length decreases with age. It ranges from 83.6 in the unsexed Stage-I group to 77.85 in the female Stage VI and 73.2 in the male Stage VI.

Humerus

We shall consider in the percentage table only the left side, but both sides are listed in the later and more detailed tables in order to show the differences in the means. It should be noted, however, that total numbers of bones were averaged. Therefore, the means should not be used to contrast the two sides. Tables are also prepared to show the relative variability of the differences in lengths so that percentage values indicate the number of times the left is greater than the right and right is greater than left, as well as the times that the sizes are the same, within 1 mm.

Humerus length was also measured according to techniques used by Schultz. The fixed arm of the anthropometer is placed against the head of the bone, holding the bar parallel to the long axis of the bone. Then the sliding arm is placed against the lateral condyle. This length approximates one which would be obtained on the outer body.

Humeral length

	Male	*Female*
	Per cent of Stage VI	Per cent of Stage VI
Stage I*	48.2	....
II**	64.0	63.3
III	76.0	83.9
IV	89.5	98.0
V	98.8	100.6
VI	100.0	100.0

* Unsexed.
** Tentatively sexed.

In measuring the long bones, many of the bones were wet and therefore good epiphyseal portions were present. Thus, these measurements,

although somewhat misleading, represent better approximations than entirely dry measurements would offer. The female has again nearly finished her growth by Stage IV.

Septal apertures are common in the humerus. The frequencies are listed in a table at the end of the section.

The final growth from Stage V to Stage VI is not statistically significant. The epiphyses, however, show that some growth may still occur in Stage V. This will be discussed under epiphyses.

The claviculo-humeral index remains much the same throughout the growth period. This is interesting because the values obtained on the clavicle are only approximations, at best, on the early ages. The values range from 33.7 to 38.4.

Radius

The study of the growth of the left radius parallels rather closely that of the humerus.

Radial growth

	Male	*Female*
	Per cent of Stage VI	Per cent of Stage VI
Stage I*	43.8	....
II**	65.5	65.1
III	75.3	84.1
IV	87.1	96.8
V	99.0	102.0
VI	100.0	100.0

* Unsexed.
** Tentatively sexed.

In the radius, also, the female stability appears by Stage IV.

Since ulnar growth closely parallels that of the radius, the length of the ulna was not taken.

Mid-shaft circumferences were done on all the long bones. These were then assessed as ratios in terms of the bone lengths. The tables of skeletal indices include these values. Growth affects these indices very little. The humeral index varies between 20.4 and 24.8 and is not dependent upon any regular increase or decrease in either sex. The radial index varies between 15.0 and 18.1, reaching the highest value in the male of Stage VI, varying rather indiscriminately throughout the growth period.

The same lack of change is noticed in the brachial index, which varies between 80.3 and 82.5. The intermembral index, also, is remarkably constant, varying between 115.0 and 118.4.

It would appear from the foregoing discussion that the long bones are well established in their interrelationships before the full deciduous dentition is attained and that succeeding growth is merely one of total deposition, rather than one of incremental and partial growth.

The pelvis

The hipbone is a rather complicated structure on which to study any growth processes. It starts out as three separate bones, each capable of possessing its own growth potential. Later, these three bones fuse and take on the properties of a plate of bone capable of extending itself in many directions.

For this reason the innominate bone is studied fractionally throughout. A point is determined in the acetabulum as described by Schultz (1930). From this point, the maximum iliac length is measured. Using this same point again, a distance is measured from it to the medial margin of the pubic bone at symphysion. Using the point yet again, a distance is measured through the posterior ramus of the ischium to the ischial tuberosity, using the ramus as an axis.

On the ilium, there are several other measurements which indicate a more functional portion of innominate growth. One is the maximum iliac breadth from the anterior superior iliac spine. Using the spinous point again, a breadth is measured to the anterior margin of the sacral surface, producing an iliac fossa breadth. Next, the sacral surface breadth itself is measured; this is the maximum breadth perpendicular to the long axis of the surface. After this, the two innominate bones are articulated with the sacrum. The cartilage of the symphysis is, of course, lost, so that the pubic symphysis is open. With this position, the maximum bi-iliac breadth is obtained. Then, using the arcuate lines as landmarks, the maximum breadth of the true pelvis is obtained. Finally, in an antero-posterior direction, one measurement is obtained from the base point, symphysion. This is to promontorium on the sacrum. The last is the distance to a plane tangent to the iliac crests above the sacrum, from promontorium. In this manner, we obtain ten measurements on the pelvis, three related directly to fractional growth and seven related to total growth.

The first three—iliac, pubic, and ischial lengths—will be treated together.

	Iliac growth		*Pubic growth*		*Ischial growth*	
	M	F	M	F	M	F
Stage I*	48.8	....	42.8	....	47.0	....
II**	64.0	64.6	59.0	56.8	62.8	71.2
III	71.0	80.8	67.7	71.4	72.0	74.9
IV	83.6	98.2	85.6	93.0	93.0	96.6
V	99.0	100.8	96.6	95.6	98.8	101.1
VI	100.0	100.0	100.0	100.0	100.0	100.0

* Unsexed.
** Tentatively sexed.

Some differential growth appears in this table. The pubic starts out somewhat below the ilium and the ischium. It then catches up by Stage III and IV, but is slightly behind until the final size is reached. Otherwise, growth is rather consistent throughout both sexes. Growth between Stages V and VI is not statistically significant.

The remaining seven dimensions are more indicative of total innominate growth. The maximum iliac breadth and the iliac fossa breadth indicate the functional growth of the attachments for the abdominal and iliacus muscles.

	Iliac breadth		*Iliac fossa breadth*	
	M	F	M	F
Stage I*	46.2	....	44.8	....
II**	59.7	55.7	56.5	50.5
III	70.7	77.1	68.7	71.2
IV	80.0	100.3	81.2	95.0
V	98.8	101.2	97.0	99.8
VI	100.0	100.0	100.0	100.0

* Unsexed.
** Tentatively sexed.

The male and female iliac breadths start out about the same, but the female soon surpasses the male and completes its growth by Stage IV. The iliac fossa breadth, however, is somewhat slower and does not attain its full breadth until Stage V. This apparent increase is due more to the shifting of the point on the anterior margin of the sacral

surface, permitting a greater maximum fossa breadth, than it is due to any actual growth of the whole iliac bone. Growth between Stages V and VI is not significant statistically.

The growth of the sacral surface indicates the attainment of the functional support of the sacrum and the innominate bones.

Sacral surface breadth

	Male	*Female*
Stage I*	63.5	....
II**	68.6	69.9
III	70.1	89.2
IV	87.7	95.1
V	99.8	92.7
VI	100.0	100.0

* Unsexed.
** Tentatively sexed.

The excessive growth of the female shows that she attains her main functional support by Stage III, while the male requires another stage to equal her attainment. No significant growth occurs in the male after Stage V. That of the female may be more significant, but Stage V does not have a large enough number to warrant statistical analysis.

The maximum pelvic breadth represents the most exaggerated growth process of all parts of the skeleton. It undergoes a very rapid increase up to Stage IV before it tapers off.

Maximum pelvic breadth

	Male	*Female*
Stage I*	42.5	....
II**	62.0	54.9
III	72.0	77.5
IV	85.8	98.0
V	97.9	100.5
VI	100.0	100.0

* Unsexed.
** Tentatively sexed.

The final growth between Stages V and VI in the male is not statistically significant. This dimension is one which is of definite value in determining sex, since it is so indicative of the great divergence in sizes of the two sexes.

The two inlet diameters also follow the processes of growth of the surrounding bones.

	Inlet breadth		*Promontorium-symphysion*	
	Male	*Female*	*Male*	*Female*
Stage I*	39.6	....	45.3	....
II**	58.1	50.2	73.0	53.6
III	70.1	69.3	75.5	83.5
IV	86.1	92.3	94.2	102.3
V	96.1	97.6	100.6	104.8
VI	100.0	100.0	100.0	100.0

* Unsexed.
** Tentatively sexed.

These two dimensions both reach a good proportion of their final size at a comparatively early time. The second, promontorium-symphysion, is somewhat variable due to the fact that occasionally the last lumbar vertebra may become sacralized. Whether this last vertebra should be considered as now sacral is questionable. It was not considered as such in measurements taken in this series.

The pelvic inlet index is the most variable of any of the skeletal indices. Stage I has a value of 62.6. The female varies from 53.8 in Stage II to 71.7 in Stage VI. The male has a value of 57.7 in Stage II and one of 71.0 in Stage VI. There is apparently very little sexual difference in the index.

The final pelvic measurement is that concerning the promontorium-iliac crest height.

	Promontorium-iliac crest	
	Male	*Female*
Stage I*	40.8	....
II**	61.8	69.5
III	67.5	....
IV	93.0	90.5
V	91.0	88.0
VI	100.0	100.0

* Unsexed.
** Tentatively sexed.

About all that can be said of this table is that it indicates a rather early time for the attainment of size of the iliac blade in relation to

the articulation with the sacrum. Male and female appear to be about the same in this respect.

Femur

Femoral growth follows much the same pattern as does that of the humerus. This has already been indicated by indices discussed earlier. Femoral length was taken as described by Schultz. The fixed arm of the anthropometer is placed on the superior margin of the greater trochanter, with the movable arm against the inferior surface of the lateral condyle, the bar being held parallel to the long axis of the shaft.

Femoral length

	Male	*Female*
Stage I*	48.0	....
II**	63.7	63.5
III	77.6	86.0
IV	90.8	96.5
V	100.3	101.0
VI	100.0	100.0

* Unsexed.
** Tentatively sexed.

These percentage values are very near those of the humerus. Final growth is attained by Stage V.

Tibia

In measuring the left tibia, the fixed arm of the anthropometer is placed with its tip on the medial edge of the head of the tibia; the movable arm is placed on the most distal margin of the medial maleolus, with the bar held parallel to the long axis of the shaft.

Tibial growth

	Male	*Female*
Stage I*	49.2	....
II**	65.8	68.0
III	75.9	85.0
IV	90.5	96.0
V	100.3	102.4
VI	100.0	100.0

* Unsexed.
** Tentatively sexed.

The percentage table for the tibia follows closely that for the radius. The fibula, because it follows the tibia closely as the ulna follows the radius, was not measured.

Mid-shaft measurements were made on the lower long bones also. The femoral index varied from 26.6 to 31.1, not being correlated with age or sex. Tibial index varied from 24.9 to 28.8, with the female being slightly lower than the male, indicating somewhat more slender tibiae.

Asymmetries and variations

Two types of variability were studied on the skeleton. The first was that of the general population; the second was that of the two subgroups defined in the section on the skulls.

Variabilities in the general population were considered only from the standpoint of asymmetries of the long bones and also from the standpoint of the appearance of the septal aperture of the humerus. These analyses are contained in the tables at the end of the section, so will not be discussed further here.

The numbers of skeletons available for comparisons of group B and L were, unfortunately, small. Twenty-nine group B type and seventeen group L type were used. Statistical analysis on these small samples could not serve to do more than indicate trends. This analysis is presented in tabular form at the end of the section, also. Suffice it to say here that there is an indication that Group B may have a shorter clavicle, a wider pelvis, and perhaps a shorter scapula. Some indication appears that Group B may be longer armed and shorter legged than Group L, but the evidence is far from conclusive. Since this study is not primarily one of taxonomy, no further discussion of group dichotomy will be made.

Epiphyseal union

Each dental age stage was studied separately and the conditions of the epiphyses were assessed. These conditions were fivefold in nature. An epiphysis may be cartilaginous, have an ossification center, be starting union, have completed union recently, or have completed union at an earlier date. A brief nomenclature is used for this variability:

1. Cartilage ..... ct.
2. Ossification center, not closed ..... ocwo
   (Ossification center, wide open.)

3. Ossification center, beginning union ..... b
4. Ossification center, recent union ..... r
5. Ossification center, earlier union cc
(Completely closed.)

A sixth type of condition is found in such bones as the sacrum in which fusion may occur without the aid of a special ossification center. Here the first abbreviation may be omitted and the second, contracted to "wo."

In this manner, the varying stages of epiphyseal union in the growth processes may be assessed and recorded for each age. The total picture may then be presented in tabular form except for one difficulty. No dental age need necessarily show 100 per cent of any condition. But, since a regular progression is retained, a modal presentation of the condition prevalent at any one age will indicate the optimum condition at that time. This modal condition may be expressed in terms of the largest percentage of cases showing any one condition.

Since the younger ages are represented, at best, by only a moderate number of skeletons, we should not be too confident of percentage values. These, however, are the best which can be used under the circumstances. A reference to the tables on skeletal metric values will indicate the numbers available in each case.

One abnormal type of fusion of bony structures was recorded. This was the fusion of the innominate bones to the sacrum. It was found that two adult individuals, male, had both sides fused, two had only the left fused, and three had only the right fused. This condition is probably one of senility. The pubic symphysis was never found to be fused.

From the tables we may obtain the order of epiphyseal union, even if we cannot obtain any time intervals actually required for the closure. These may be listed in order. Some may be close together, with arbitrary assignments of their orders.

Order of epiphyseal union

1. Distal elements of humerus with one another
2. Neural arch of vetebrae
3. Fractions of the atlas
4. Fractions of the epistropheus
5. Calcaneus
6. Capitulum of humerus to shaft
7. Trochlea of humerus to shaft
8. Distal epiphysis of humerus
9. Acetabulum portions
10. Coracoid process of scapula
11. Medial epicondyle of humerus
12. Tubercle of ribs
13. Head of ribs
14. Proximal epiphysis of ulna
15. Phalanges of toes
16. Proximal epiphysis of radius
17. Head of femur
18. Lesser trochanter of femur
19. Phalanges of fingers
20. Greater trochanter of femur
21. Metatarsal epiphyses
22. Metacarpal epiphyses
23. Head of humerus
24. Acromion of scapula
25. Distal epiphysis of tibia
26. Distal epiphysis of fibula
27. Distal epiphysis of femur
28. Sacral elements
29. Proximal epiphysis of fibula

30. Proximal epiphysis of tibia
31. Epiphyseal plate of vertebrae
32. Distal epiphysis of radius
33. Distal epiphysis of ulna
34. Ischial tuberosity
35. Vertebral margin of scapula
36. Iliac crest
37. Clavicle, medial epiphysis

This order differs in several rather important aspects from data for chimpanzee and orang-utan as listed by Schultz (1940a, 1941). Direct comparisons of these discrepancies must wait until a later date.

A small sample of the long bones was studied by X-ray in order to assess the skeletal maturation in terms of human years, based upon the Todd-Brush (1937a, b) standards. The skull X-rays were also assessed in terms of human dental years, as defined by Broadbent (1937). An interesting relationship appeared which may be highly significant.

Relation of dental age to skeletal age

		Skull			*Skeleton*		
Stage		No.	Mean age	Range	No.	Mean age	Range
I	Unsexed	6	4y.6m.	4y.-5y.6m.	1	9y.5m.	.....
II	Male	18	6y.10m.	6y.-8y.	9	9y.9m.	8y.9m.-11y.
	Female	3	6y.6m.	6y.6m.	2	8y.6m.	7y.1m.-10y.
III	Male	17	9y.5m.	8y.6m.-11y.	6	12y.6m.	11y.10m.-13y.3m.
	Female	9	9y.10m.	8y.6m.-10y.	2	9y.5m.	8y.1m.-10y.9m.
IV	Male	1	16y.	.....	4	14y.	13y.-15y.4m.
	Female	1	13y.	.....	6	13y.1m.	12y.5m.-14y.4m.
V	Male	1	20y.	.....	3	16y.	14y.-18y.

This sequence indicates a possibility that the dentition of the gorilla may be relatively slow as compared with the skeleton. This would be expected in a species which must be able to fend for itself at an early age. But even here, the female appears to reach her functional maturity by Stage III as she does in other aspects of her growth.

The sex differences in epiphyseal union are especially interesting. The medial epicondyle of the humerus closes slightly earlier in the female than in the male. The same thing is true of the distal epiphysis of the radius and the proximal epiphysis of the ulna. The phalanges of the toes appear to close somewhat earlier in the female, also. The epiphyseal plates of the vertebrae of the male begin their closure a short time before those of the female. The male is also ahead of the female in the closing of the rib epiphyses. The female precedes the male in the closure of the coracoid process, the acromion, and the vertebral margin of the scapula. The female is also ahead of the male in the closing of the acetabulum, but the male precedes the female in the iliac crest epiphysis and the ischial tuberosity.

In other epiphyses, the sexes are approximately the same in the times of closure.

Modal condition of epiphyses at age stages

	I	II	III		IV		V		VI	
			M	*F*	*M*	*F*	*M*	*F*	*M*	*F*
Humerus										
Head	ocwo 100	ocwo 100	ocwo 100	ocwo 100	ocwo 90	ocwo 66	b-cc 66	b-cc 73	cc 95	cc 92
Elements	ocwo 80	cc 58	cc 80	cc 67	cc 90	cc 100	cc 100	cc 100	cc 100	cc 100
Distal	ocwo 100	ocwo 100	ocwo 80	ocwo 100	b 40	cc 44	r-cc 97	r-cc 100	cc 100	cc 100
Capitulum	ocwo 100	ocwo 92	ocwo 55	ocwo 100	b 57	cc 100	cc 100	cc 100	cc 100	cc 100
Trochlea	ocwo 100	ocwo 83	ocwo 55	ocwo 100	b 57	cc 100	cc 100	cc 100	cc 100	cc 100
Med. epi.	ct 60	ocwo 71	ocwo 90	ocwo 100	ocwo 50	r 44	r-cc 93	r-cc 100	cc 100	cc 100
Radius										
Proximal	ocwo 100	ocwo 100	ocwo 90	ocwo 100	ocwo 77	ocwo 66	r-cc 83	r-cc 90	cc 98	cc 95
Distal	ocwo 100	ocwo 100	ocwo 100	ocwo 100	ocwo 100	ocwo 66	ocwo 43	b 45	cc 95	cc 95
Ulna										
Proximal	ct 60	ct 71	ct 50	ct 67	oc-b 60	cc 44	cc 86	cc 100	cc 100	cc 100
Distal	ocwo 100	ocwo 100	ocwo 100	ocwo 100	ocwo 100	ocwo 66	ocwo 43	b 54	cc 95	cc 92
Femur										
Head	ocwo 100	ocwo 100	ocwo 100	ocwo 100	ocwo 63	r 55	r-cc 81	r-cc 90	cc 97	cc 97
Gt. troch.	c-oc 80	ocwo 100	ocwo 80	ocwo 100	ocwo 72	b 44	r-cc 78	r-cc 100	cc 100	cc 100
L. troch.	ct 100	ct 46	ocwo 50	c-oc 100	ocwo 54	cc 55	r-cc 81	r-cc 100	cc 100	cc 100
Distal	ocwo 100	ocwo 100	ocwo 90	ocwo 100	ocwo 80	b 55	r-cc 55	r-cc 72	cc 95	cc 95
Tibia										
Proximal	ocwo 100	ocwo 100	ocwo 90	ocwo 100	ocwo 90	ocwo 55	cc 35	cc 36	cc 97	cc 95
Distal	ocwo 100	ocwo 100	ocwo 90	ocwo 100	ocwo 72	ocwo 55	r-cc 65	r-cc 72	cc 95	cc 95
Fibula										
Proximal	c-oc 80	ocwo 93	ocwo 100	ocwo 100	ocwo 100	ocwo 55	r-cc 48	r-cc 72	cc 95	cc 97
Distal	ocwo 100	ocwo 100	ocwo 100	ocwo 100	ocwo 90	ocwo 66	r-cc 64	r-cc 72	cc 100	cc 95

	I	II	III M	III F	IV M	IV F	V M	V F	VI M	VI F
Corpus										
Metacarpals	ocwo 100	ocwo 100	ocwo 80	ocwo 100	ocwo 90	b 43	r-cc 76	r-cc 81	cc 100	cc 100
Phalanges	ocwo 100	ocwo 100	ocwo 80	ocwo 75	ocwo 80	b-cc 86	r-cc 78	r-cc 100	cc 100	cc 100
Tarsus										
Metatarsals	ocwo 100	ocwo 100	ocwo 70	ocwo 100	ocwo 90	ocwo 43	r-cc 77	r-cc 81	cc 100	r-cc 100
Phalanges	ocwo 100	ocwo 100	ocwo 70	ocwo 75	ocwo 80	cc 43	r-cc 86	r-cc 100	cc 100	cc 100
Calcaneus	ct 100	ocwo 54	ocwo 55	c-oc 100	b-r 70	b-r 86	r-cc 86	r-cc 100	cc 100	cc 100
Vertebrae										
Ep. plates	ocwo 67	ocwo 100	ocwo 80	ocwo 50	ocwo 90	ocwo 66	cc 33	ocwo 45	cc 91	cc 87
Neural arch	o 80	cc 43	b-cc 100	b-cc 100	cc 100	cc 88	cc 97	cc 100	cc 100	cc 100
Atlas	o-cc 100	o 54	b-cc 88	b-cc 67	cc 100	cc 88	cc 100	cc 100	cc 100	cc 100
Epistropheus	b 50	o 36	cc 40	cc 100	cc 100	cc 77	r-cc 100	r-cc 90	cc 100	cc 100
Sacrum	o 80	o 100	o 66	o 75	o 70	b 77	cc 50	b 54	cc 93	cc 89
Ribs										
Head	ct 100	ct 100	ocwo 77	c-oc 100	ocwo 70	ocwo 55	r-cc 87	r-cc 80	cc 98	cc 100
Tubercle	ct 100	ct 77	ct 55	c-oc 100	ct 50	b-r 55	r-cc 90	r-cc 70	cc 98	cc 100
Clavicle										
Med. epi.	ct 100	ct 100	ct 100	ct 100	ct 100	ct 100	o 78	o 80	cc 75	cc 88
Scapula										
Coracoid	ct 100	ocwo 93	ocwo 90	ocwo 100	ocwo 80	b-cc 55	r-cc 93	r-cc 100	cc 100	cc 100
Acromion	ct 100	ct 100	ct 90	c-oc 100	c-oc 100	c-oc 66	cc 66	cc 54	cc 100	cc 100
Vert. margin	ct 100	ct 100	ct 90	c-oc 100	c-oc 100	c-oc 100	ocwo 49	ocwo 45	cc 89	cc 78
Pelvis										
Acetabulum	o 100	o 100	o 70	o 100	o 60	cc 44	r-cc 97	r-cc 100	cc 100	cc 100
Iliac crest	ct 100	ct 85	ocwo 90	ct 50	ocwo 55	c-oc 77	o-b 75	o-b 81	cc 88	cc 81
Is. tub.	ct 100	ct 77	ct 80	ct 50	ocwo 70	c-oc 55	b 33	b 50	cc 93	cc 90

SKELETAL MEASUREMENTS

Dental age I

	NUMBER	MEAN	RANGE
Right humerus	4	209.5	178-278
Left humerus	4	211.0	180-281
Right radius	3	154.0	150-157
Left radius	2	154.0	150-158
Right humerus + radius	3	340.7	328-348
Left humerus + radius	2	339.0	330-348
Right femur	4	180.5	150-232
Left femur	4	178.8	145-235
Right tibia	4	144.8	124-186
Left tibia	4	146.0	122-189
Right femur + tibia	4	325.2	274-418
Left femur + tibia	4	324.8	267-424
Circumferences			
a. Humerus	4	52.0	44-68
b. Radius	4	32.5	29-41
c. Ulna	4	34.0	28-43
d. Femur	4	56.0	47-76
e. Tibia	4	41.5	36-54
f. Fibula	4	24.2	20-28
Breadth vertebra			
a. T7	3	20.7	16-27
b. L2	4	24.8	20-32
Sternum			
a. Manubrium length	4	33.2	26-43
b. Corpus length	4	60.2	44-80
c. Sternum length	4	92.2	70-123
d. Manubrium breadth	4	41.2	36-46
e. Corpus breadth	4	25.8	18-36
Scapula			
a. Length	4	76.2	67-100
b. Upper breadth	1	35.0	....
c. Lower breadth	1	49.0	....
Pelvis			
a. Iliac length	3	115.3	100-143
b. Ischial length	4	60.0	51-75
c. Pubic length	4	50.5	44-60
d. Iliac breadth	3	98.7	83-126
e. Iliac fossa	3	75.0	67-90
f. Sacral surface	1	25.0	....
g. Maximum breadth	2	173.5	170-177
h. Inlet breadth	3	55.0	49-59
i. Prom-symphysion	3	88.8	81-95
j. Prom-crest	2	43.0	37-49
Clavicle length	4	80.2	70-101
Patellar breadth	2	18.5	17-20
Skeletal age	1	9.5	....

Male dental age II

	NUMBER	MEAN	RANGE
Right humerus	6	284.3	257-318
Left humerus	6	286.3	261-321
Right radius	6	232.3	216-261
Left radius	7	231.4	214-262
Right humerus + radius	5	523.0	478-579
Left humerus + radius	6	518.7	480-583
Right femur	8	236.0	209-275
Left femur	7	237.9	211-275
Right tibia	7	195.7	173-222
Left tibia	7	195.3	176-222
Right femur + tibia	7	435.6	392-497
Left femur + tibia	6	436.7	394-497
Circumferences			
a. Humerus	7	63.6	68-71
b. Radius	7	38.3	35-42
c. Ulna	7	43.3	39-48
d. Femur	7	69.7	64-78
e. Tibia	7	44.4	48-58
f. Fibula	7	28.3	25-32
Breadth vertebra			
a. T7	6	24.3	21-27
b. L2	7	32.6	27-40
Sternum			
a. Manubrium length	6	46.8	39-56
b. Corpus length	6	75.8	67-89
c. Sternum length	6	122.0	106-143
d. Manubrium breadth	6	49.5	45-52
e. Corpus breadth	6	33.2	27-39
Scapula			
a. Length	9	98.9	79-120
b. Upper breadth	7	52.7	39-61
c. Lower breadth	7	77.3	64-89
Pelvis			
a. Iliac length	7	151.6	135-178
b. Ischial length	7	80.1	72-96
c. Pubic length	7	69.6	60-85
d. Iliac breadth	7	127.3	116-142
e. Iliac fossa	7	94.6	86-104
f. Sacral surface	5	27.0	24-30
g. Maximum breadth	5	253.6	237-278
h. Inlet breadth	6	80.5	73-90
i. Prom-symphysion	5	142.6	120-176
j. Prom-crest	4	65.2	60-76
Clavicle length	8	97.4	81-115
Patellar breadth	4	23.0	20-27
Skeletal age	9	9.9	8.9-11.0

Male dental age III

	NUMBER	MEAN	RANGE
Righ. humerus	8	335.9	306-367
Left humerus	8	332.1	289-369
Right radius	5	268.2	244-295
Left radius	9	265.1	225-297
Right humerus + radius	6	597.3	550-664
Left humerus + radius	9	596.3	514-666
Right femur	8	278.5	239-321
Left femur	8	289.8	257-324
Right tibia	9	226.1	191-252
Left tibia	8	225.1	186-255
Right femur + tibia	8	502.1	430-573
Left femur + tibia	7	519.7	468-579
Circumferences			
a. Humerus	10	75.6	62-85
b. Radius	10	45.3	35-53
c. Ulna	9	50.7	40-60
d. Femur	10	83.4	65-94
e. Tibia	10	62.6	50-72
f. Fibula	10	33.6	25-40
Breadth vertebra			
a. T7	9	27.2	24-31
b. L2	9	36.3	30-40
Sternum			
a. Manubrium length	10	50.3	44-55
b. Corpus length	9	87.6	72-112
c. Sternum length	9	137.6	117-159
d. Manubrium breadth	10	57.1	48-65
e. Corpus breadth	9	37.9	27-52
Scapula			
a. Length	10	113.8	94-128
b. Upper breadth	7	59.4	54-68
c. Lower breadth	8	91.5	77-103
Pelvis			
a. Iliac length	6	168.2	155-179
b. Ischial length	9	91.8	75-105
c. Pubic length	9	79.8	64-90
d. Iliac breadth	8	150.9	126-172
e. Iliac fossa	8	114.9	102-123
f. Sacral surface	5	29.6	24-37
g. Maximum breadth	6	294.2	250-322
h. Inlet breadth	6	97.2	88-107
i. Prom-symphysion	5	148.0	132-161
j. Prom-crest	5	71.2	60-86
Clavicle length	9	122.1	108-138
Patellar breadth	4	30.8	26-34
Skeletal age	6	12.6	11.10-13.3

Male dental age IV

	NUMBER	MEAN	RANGE
Right humerus	8	388.8	332-427
Left humerus	9	390.6	337-425
Right radius	10	315.4	280-338
Left radius	7	307.4	275-332
Right humerus + radius	8	702.2	612-748
Left humerus + radius	7	693.6	612-750
Right femur	10	338.5	285-361
Left femur	10	338.9	284-360
Right tibia	10	271.0	231-288
Left tibia	10	268.6	232-287
Right femur + tibia	10	609.5	516-644
Left femur + tibia	10	607.5	516-647
Circumferences			
a. Humerus	9	83.3	69-94
b. Radius	10	52.0	44-60
c. Ulna	10	56.8	48-66
d. Femur	10	94.2	80-107
e. Tibia	10	71.5	60-81
f. Fibula	10	35.7	31-39
Breadth vertebra			
a. T_7	9	32.0	27-38
b. L_2	11	40.1	32-48
Sternum			
a. Manubrium length	9	62.7	49-78
b. Corpus length	4	102.8	95-109
c. Sternum length	4	160.8	151-170
d. Manubrium breadth	9	68.6	57-82
e. Corpus breadth	4	42.8	36-51
Scapula			
a. Length	9	140.6	127-154
b. Upper breadth	5	71.2	57-90
c. Lower breadth	5	111.2	91-135
Pelvis			
a. Iliac length	3	198.0	171-230
b. Ischial length	8	118.5	99-135
c. Pubic length	8	101.0	90-112
d. Iliac breadth	5	170.8	146-212
e. Iliac fossa	5	135.8	120-168
f. Sacral surface	8	34.5	32-37
g. Maximum breadth	3	351.3	306-418
h. Inlet breadth	6	119.2	103-137
i. Prom-symphysion	5	184.8	143-202
j. Prom-crest	1	98.0	....
Clavicle length	11	143.3	128-159
Patellar breadth	8	35.4	31-41
Skeletal age	4	14.0	13.0-15.4

Male dental age V

	NUMBER	MEAN	S. D.	S. E.	C. V.	RANGE
Right humerus	28	431.2	26.00	4.91	6.04	389-496
Left humerus	26	432.5	25.62	5.03	5.94	388-492
Right radius	27	348.6	18.91	3.64	5.42	311-382
Left radius	25	349.2	19.20	3.84	5.51	312-387
Right humerus + radius	26	780.5	42.50	8.35	5.45	700-878
Left humerus + radius	22	786.5	45.60	9.92	5.80	700-879
Right femur	29	374.4	22.90	4.24	6.13	317-424
Left femur	29	374.6	23.20	4.30	6.20	319-422
Right tibia	25	303.1	18.18	3.64	6.00	266-329
Left tibia	28	298.5	16.85	3.18	5.65	262-334
Right femur + tibia	25	675.4	40.80	8.16	6.04	583-753
Left femur + tibia	28	673.1	35.00	6.60	5.20	581-755
Circumferences						
a. Humerus	28	101.7	7.81	1.47	7.70	83-115
b. Radius	29	62.0	5.21	0.97	8.42	51-72
c. Ulna	29	68.2	5.71	1.06	8.38	56-77
d. Femur	29	110.2	7.80	1.44	7.07	92-125
e. Tibia	28	78.8	6.25	1.18	7.95	69-93
f. Fibula	29	41.7	4.41	0.82	10.58	34-48
Breadth vertebra						
a. T7	27	35.0	4.05	0.78	11.57	27-42
b. L2	28	43.0	3.76	0.71	8.77	34-50
Sternum						
a. Manubrium length	25	69.6	9.16	1.83	13.13	47-85
b. Corpus length	7	132.3	....	....	....	119-144
c. Sternum length	7	197.3	....	....	....	166-226
d. Manubrium breadth	24	85.9	12.10	2.47	12.10	61-105
e. Corpus breadth	14	49.6	....	....	....	29-61
Scapula						
a. Length	24	164.2	12.20	2.49	7.44	132-193
b. Upper breadth	16	92.7	6.95	1.74	7.50	76-105
c. Lower breadth	17	136.9	12.41	3.01	9.07	109-159
Pelvis						
a. Iliac length	20	234.2	12.72	2.84	5.44	208-262
b. Ischial length	20	125.9	9.80	2.19	7.80	93-144
c. Pubic length	25	114.0	11.00	2.20	9.66	94-136
d. Iliac breadth	22	209.3	14.25	3.04	6.82	182-231
e. Iliac fossa	21	162.0	11.88	2.59	7.35	136-187
f. Sacral surface	26	39.3	3.85	0.76	9.80	32-46
g. Maximum breadth	20	400.0	26.62	5.96	6.67	341-449
h. Inlet breadth	25	133.2	12.98	2.60	9.69	116-158
i. Prom-symphysion	26	197.7	19.38	3.81	9.83	160-237
j. Prom-crest	14	95.9	....	....	....	81-116
Clavicle length	23	157.5	11.00	2.29	6.90	130-178
Patellar breadth	24	42.8	4.08	0.83	9.54	30-51
Skeletal age	3	16.0	....	....	....	14-18

Male dental age VI

	NUMBER	MEAN	S. D.	S. E.	C. V.	RANGE
Right humerus	56	437.8	21.90	2.93	5.00	399-486
Left humerus	52	438.2	22.00	3.05	5.02	398-488
Right radius	59	350.9	17.00	2.21	4.85	309-392
Left radius	56	352.4	16.90	2.26	4.80	311-395
Right humerus + radius	55	789.2	38.40	5.18	4.85	711-871
Left humerus + radius	50	791.6	37.58	5.31	4.74	711-874
Right femur	56	375.2	16.80	2.22	4.48	333-406
Left femur	57	373.4	18.30	2.42	4.91	334-411
Right tibia	56	300.8	18.81	2.52	6.29	271-342
Left tibia	54	297.1	15.00	2.04	5.05	266-337
Right femur + tibia	52	675.9	30.63	4.25	4.54	614-747
Left femur + tibia	52	671.1	31.15	4.31	4.65	603-742
Circumferences						
a. Humerus	59	107.4	5.87	0.76	5.41	94-122
b. Radius	60	63.6	3.98	0.52	6.26	57-74
c. Ulna	59	70.2	5.16	0.67	7.36	61-90
d. Femur	60	115.3	5.64	0.73	4.88	100-130
e. Tibia	60	85.6	4.82	0.62	5.62	75-102
f. Fibula	59	43.7	2.78	0.36	6.35	38-52
Breadth vertebra						
a. T7	57	35.0	3.02	0.40	8.60	29-41
b. L2	56	44.2	3.27	0.44	7.40	37-52
Sternum						
a. Manubrium length	41	77.9	8.23	1.28	10.53	62-95
b. Corpus length	17	131.0	13.85	3.36	10.56	106-154
c. Sternum length	21	208.6	19.70	4.30	9.43	179-241
d. Manubrium breadth	56	97.2	10.72	1.44	11.02	67-122
e. Corpus breadth	39	56.0	7.25	1.16	12.91	38-73
Scapula						
a. Length	57	170.4	7.54	1.00	4.41	155-183
b. Upper breadth	56	93.8	6.94	0.93	7.48	78-110
c. Lower breadth	56	141.0	14.01	1.88	9.95	112-171
Pelvis						
a. Iliac length	55	236.9	10.38	1.40	4.39	210-263
b. Ischial length	54	127.4	6.72	0.92	5.28	110-141
c. Pubic length	55	118.0	7.37	1.00	6.25	100-135
d. Iliac breadth	58	213.8	11.32	1.49	5.31	191-241
e. Iliac fossa	58	167.2	9.01	1.18	5.38	145-188
f. Sacral surface	53	39.4	3.54	0.49	8.96	31-51
g. Maximum breadth	52	409.6	20.10	2.78	4.89	375-453
h. Inlet breadth	56	138.7	9.21	1.23	6.60	121-166
i. Prom-symphysion	55	196.2	12.21	1.66	6.26	163-250
j. Prom-crest	48	105.4	9.95	1.44	9.42	82-132
Clavicle length	48	166.0	9.85	1.42	5.96	142-190
Patellar breadth	42	41.5	3.92	0.60	9.45	35-51
Skeletal age	..	....	....	....	....	....

Female dental age II

	NUMBER	MEAN	RANGE
Right humerus	5	232.4	199-260
Left humerus	2	230.5	201-260
Right radius	3	185.7	164-213
Left radius	4	189.8	161-213
Right humerus + radius	4	424.0	363-473
Left humerus + radius	2	417.5	362-473
Right femur	3	198.0	174-228
Left femur	3	193.7	174-213
Right tibia	4	163.8	144-187
Left tibia	5	166.8	144-184
Right femur + tibia	3	359.0	318-415
Left femur + tibia	3	353.3	318-396
Circumferences			
a. Humerus	5	55.8	55-58
b. Radius	5	33.0	31-35
c. Ulna	5	35.8	34-38
d. Femur	4	57.8	56-59
e. Tibia	5	42.4	39-45
f. Fibula	5	22.6	19-24
Breadth vertebra			
a. T7	3	22.0	....
b. L2	2	25.5	24-27
Sternum			
a. Manubrium length	5	35.8	32-38
b. Corpus length	5	65.0	53-79
c. Sternum length	5	100.8	85-114
d. Manubrium breadth	5	42.0	37-48
e. Corpus breadth	5	26.4	20-33
Scapula			
a. Length	4	83.2	75-90
b. Upper breadth	3	42.0	35-46
c. Lower breadth	3	57.7	49-64
Pelvis			
a. Iliac length	2	127.5	126-129
b. Ischial length	2	70.0	68-72
c. Pubic length	3	55.0	44-62
d. Iliac breadth	3	95.0	81-101
e. Iliac fossa	3	68.7	58-77
f. Sacral surface	3	22.7	21-26
g. Maximum breadth	2	182.0	162-202
h. Inlet breadth	3	62.0	57-67
i. Prom-symphysion	2	93.0	71-115
j. Prom-crest	1	54.0	....
Clavicle length	4	86.8	80-90
Patellar breadth	2	23.5	21-26
Skeletal age	2	8.6	7.1-10.0

Female dental age III

	NUMBER	MEAN	RANGE
Right humerus	2	307.5	305-310
Left humerus	1	305.0	....
Right radius	2	246.5	245-248
Left radius	2	245.0	244-246
Right humerus + radius	2	554.0	553-555
Left humerus + radius	1	551.0	....
Right femur	2	264.5	264-265
Left femur	2	262.0	261-263
Right tibia	2	211.5	211-212
Left tibia	2	208.5	208-209
Right femur + tibia	2	476.0	475-477
Left femur + tibia	2	470.5	470-471
Circumferences			
a. Humerus	2	63.0	61-65
b. Radius	2	37.0	36-38
c. Ulna	2	42.0	....
d. Femur	2	70.5	68-73
e. Tibia	2	53.5	52-55
f. Fibula	2	27.0	26-28
Breadth vertebra			
a. T7	3	23.0	22-24
b. L2	3	32.3	32-33
Sternum			
a. Manubrium length	3	41.3	37-46
b. Corpus length	2	79.0	74-84
c. Sternum length	2	118.0	115-121
d. Manubrium breadth	3	50.3	44-56
e. Corpus breadth	2	29.5	25-34
Scapula			
a. Length	2	107.0	100-114
b. Upper breadth	1	53.0	....
c. Lower breadth	1	70.0	....
Pelvis			
a. Iliac length	2	159.5	158-161
b. Ischial length	2	73.5	69-78
c. Pubic length	2	69.0	63-75
d. Iliac breadth	2	131.5	130-133
e. Iliac fossa	2	97.0	92-102
f. Sacral surface	2	29.0	28-30
g. Maximum breadth	2	257.5	257-258
h. Inlet breadth	3	85.7	82-87
i. Prom-symphysion	3	144.7	135-152
j. Prom-crest	0	....	....
Clavicle length	3	109.0	102-114
Patellar breadth	2	27.0	26-28
Skeletal age	2	9.5	8.1-10.9

Female dental age IV

	NUMBER	MEAN	RANGE
Right humerus	9	340.4	217-369
Left humerus	7	356.3	336-371
Right radius	8	279.4	253-297
Left radius	6	281.7	257-298
Right humerus + radius	8	629.5	574-656
Left humerus + radius	6	637.5	623-669
Right femur	10	297.1	247-314
Left femur	9	295.4	247-313
Right tibia	8	238.9	191-263
Left tibia	9	237.4	194-257
Right femur + tibia	9	561.6	438-574
Left femur + tibia	8	534.8	441-567
Circumferences			
a. Humerus	10	77.4	63-92
b. Radius	10	47.1	38-62
c. Ulna	10	53.3	45-69
d. Femur	10	84.9	65-94
e. Tibia	10	62.3	53-76
f. Fibula	10	32.9	26-40
Breadth vertebra			
a. T7	10	27.1	22-30
b. L2	10	33.5	27-38
Sternum			
a. Manubrium length	9	55.9	40-60
b. Corpus length	7	95.0	84-108
c. Sternum length	7	151.1	138-162
d. Manubrium breadth	9	63.4	43-79
e. Corpus breadth	7	39.3	34-42
Scapula			
a. Length	8	127.5	115-136
b. Upper breadth	6	65.8	56-70
c. Lower breadth	7	98.9	90-104
Pelvis			
a. Iliac length	5	193.8	175-211
b. Ischial length	7	94.9	84-98
c. Pubic length	8	90.0	79-99
d. Iliac breadth	5	171.2	158-184
e. Iliac fossa	5	129.0	116-139
f. Sacral surface	8	30.9	25-37
g. Maximum breadth	5	325.8	312-338
h. Inlet breadth	6	114.0	107-124
i. Prom-symphysion	6	177.8	156-192
j. Prom-crest	2	71.5	65-78
Clavicle length	9	119.0	102-131
Patellar breadth	6	31.3	27-37
Skeletal age	6	13.1	12.5-14.4

Female dental age V

	NUMBER	MEAN	RANGE
Right humerus	10	365.0	339-387
Left humerus	11	365.6	339-388
Right radius	10	295.5	280-304
Left radius	11	296.5	280-309
Right humerus + radius	9	650.3	631-690
Left humerus + radius	11	654.8	630-696
Right femur	11	307.2	299-320
Left femur	11	308.0	295-320
Right tibia	11	254.3	237-273
Left tibia	11	251.9	232-270
Right femur + tibia	11	562.4	536-589
Left femur + tibia	11	559.9	527-592
Circumferences			
a. Humerus	11	80.0	72-88
b. Radius	11	47.7	40-53
c. Ulna	11	52.1	47-61
d. Femur	11	87.3	80-95
e. Tibia	11	62.7	58-68
f. Fibula	11	33.7	30-39
Breadth vertebra			
a. T_7	11	26.7	23-31
b. L_2	11	32.9	29-35
Sternum			
a. Manubrium length	8	57.9	48-63
b. Corpus length	4	102.5	82-120
c. Sternum length	4	159.5	145-176
d. Manubrium breadth	8	63.5	59-69
e. Corpus breadth	6	40.0	34-45
Scapula			
a. Length	9	129.3	122-135
b. Upper breadth	9	65.9	61-71
c. Lower breadth	9	98.7	80-111
Pelvis			
a. Iliac length	9	199.0	188-212
b. Ischial length	10	99.4	90-106
c. Pubic length	11	92.6	82-103
d. Iliac breadth	9	172.9	163-186
e. Iliac fossa	9	135.7	126-145
f. Sacral surface	11	30.1	25-36
g. Maximum breadth	9	334.8	317-356
h. Inlet breadth	11	120.3	103-133
i. Prom-symphysion	11	181.5	164-205
j. Prom-crest	8	69.5	63-81
Clavicle length	10	131.1	125-144
Patellar breadth	9	31.1	27-34
Skeletal age	..	....	....

Female dental age VI

	NUMBER	MEAN	S. D.	S. E.	C. V.	RANGE
Right humerus	33	362.1	17.0	2.96	4.70	329-397
Left humerus	32	364.3	17.5	3.10	4.80	330-399
Right radius	33	291.5	12.8	2.23	4.40	263-315
Left radius	35	291.4	13.4	2.26	4.60	264-314
Right humerus + radius	31	653.6	28.2	5.06	4.32	592-712
Left humerus + radius	31	653.6	29.6	5.33	4.54	594-712
Right femur	36	305.3	11.9	1.99	3.91	284-333
Left femur	37	305.3	11.6	1.91	3.81	284-331
Right tibia	35	248.8	12.2	2.06	4.90	226-286
Left tibia	36	245.8	11.1	1.86	4.52	222-279
Right femur + tibia	35	554.5	23.4	3.95	4.22	510-619
Left femur + tibia	36	550.9	22.4	3.74	4.07	506-610
Circumferences						
a. Humerus	36	85.0	6.29	1.05	7.40	72-98
b. Radius	36	50.2	4.04	0.67	8.05	42-60
c. Ulna	35	55.4	4.00	0.68	7.23	47-63
d. Femur	37	90.5	8.45	1.38	9.34	77-112
e. Tibia	36	67.1	4.73	0.79	7.05	60-81
f. Fibula	37	35.6	2.52	0.41	7.08	28-41
Breadth vertebra						
a. T7	36	27.2	2.29	0.38	8.44	22-31
b. L2	36	34.7	4.20	0.70	12.10	29-45
Sternum						
a. Manubrium length	27	60.1	4.55	0.88	7.58	51-71
b. Corpus length	6	98.7	....	....	....	80-126
c. Sternum length	9	158.3	....	....	....	132-191
d. Manubrium breadth	33	71.2	7.72	1.34	10.80	56-92
e. Corpus breadth	17	41.8	5.68	1.38	13.60	32-50
Scapula						
a. Length	36	131.8	6.44	1.07	4.88	119-147
b. Upper breadth	35	69.1	4.82	0.82	6.97	61-80
c. Lower breadth	35	100.6	9.70	1.63	9.65	75-116
Pelvis						
a. Iliac length	35	197.5	4.36	0.74	2.21	181-221
b. Ischial length	35	98.2	4.76	0.80	4.85	89-111
c. Pubic length	34	96.9	6.59	1.13	6.80	83-107
d. Iliac breadth	36	170.7	12.00	2.00	7.04	152-195
e. Iliac fossa	36	136.0	8.70	1.45	6.40	114-149
f. Sacral surface	32	32.5	3.64	0.64	11.20	26-41
g. Maximum breadth	34	332.1	18.80	3.22	5.66	296-376
h. Inlet breadth	34	123.6	8.00	1.37	6.48	115-150
i. Prom-symphysion	33	173.1	15.90	2.78	9.18	134-211
j. Prom-crest	29	79.0	5.85	1.08	7.41	66-97
Clavicle length	29	135.0	7.94	1.44	5.87	116-151
Patellar breadth	29	32.3	3.02	0.56	9.36	26-37
Skeletal age	..	....	....	....	....	....

SKELETAL INDICES

Dental age I

	NUMBER	MEAN	RANGE
Brachial	3	82.5	80.8-83.8
Crural	4	81.2	80.1-83.5
Intermembral	3	116.5	111.0-121.5
Humeral	4	24.8	22.9-26.8
Radial	3	19.2	18.7-20.0
Femoral	4	31.1	27.2-32.6
Tibial	4	28.5	27.2-29.2
Pelvic inlet	3	62.6	51.7-70.4
Scapular	1	83.6	.....
Claviculo-humeral	4	38.4	36.2-39.3
Male dental age II			
Brachial	7	81.6	80.0-83.0
Crural	7	81.1	77.2-85.2
Intermembral	7	118.2	114.3-123.3
Humeral	7	22.4	20.4-24.4
Radial	7	16.6	15.9-17.3
Femoral	7	29.2	27.3-31.0
Tibial	7	27.0	25.0-28.8
Pelvic inlet	5	57.7	51.2-70.0
Scapular	7	80.1	70.3-87.2
Claviculo-humeral	7	35.2	33.5-37.1
Male dental age III			
Brachial	9	80.3	78.0-82.2
Crural	9	79.6	76.8-85.3
Intermembral	9	117.0	114.8-119.2
Humeral	9	23.2	20.9-25.9
Radial	9	17.0	15.6-18.8
Femoral	9	29.7	27.2-31.7
Tibial	9	27.8	26.6-29.0
Pelvic inlet	5	66.7	58.3-76.5
Scapular	7	76.7	69.0-83.9
Claviculo-humeral	8	36.5	33.4-39.5

SKELETAL INDICES

Male dental age IV

	NUMBER	MEAN	RANGE
Brachial	9	80.6	75.8-83.0
Crural	10	79.8	77.7-83.1
Intermembral	8	115.7	112.5-118.4
Humeral	9	21.3	20.0-23.2
Radial	10	16.5	15.0-18.6
Femoral	10	27.8	26.8-29.8
Tibial	10	26.5	24.8-28.9
Pelvic inlet	5	66.5	60.8-72.2
Scapular	5	77.3	68.5-86.0
Claviculo-humeral	9	36.1	33.6-40.0

Male dental age V

	NUMBER	MEAN	S. D.	S. E.	C. V.	RANGE
Brachial	26	80.5	1.68	0.33	2.09	75.8-85.1
Crural	28	80.7	2.07	0.39	2.57	75.2-84.5
Intermembral	25	115.3	2.74	0.55	2.37	110.9-121.5
Humeral	28	23.6	1.91	0.36	8.10	20.1-28.1
Radial	27	17.9	1.70	0.33	9.48	15.1-22.2
Femoral	29	29.5	2.02	0.37	6.83	25.6-33.9
Tibial	28	27.2	1.79	0.34	6.59	23.6-30.3
Pelvic inlet	25	67.9	7.79	1.56	11.42	54.9-81.5
Scapular	16	71.2	4.08	1.02	5.74	65.3-79.0
Claviculo-humeral	22	36.2	2.22	0.47	6.14	32.8-40.5

Male dental age VI

	NUMBER	MEAN	S. D.	S. E.	C. V.	RANGE
Brachial	60	80.4	1.94	0.25	2.42	74.6-84.0
Crural	59	80.0	2.26	0.30	2.83	74.4-86.6
Intermembral	58	117.5	2.70	0.35	2.30	112.4-124.5
Humeral	58	24.7	1.69	0.22	6.82	21.8-28.8
Radial	60	18.1	1.18	0.15	6.54	15.8-21.1
Femoral	60	31.0	1.89	0.24	6.10	27.9-38.0
Tibial	59	28.8	1.98	0.26	6.87	25.1-33.6
Pelvic inlet	54	71.0	6.08	0.83	8.56	57.5-89.5
Scapular	56	73.2	5.10	0.68	6.97	62.9-86.2
Claviculo-humeral	46	38.2	2.44	0.36	6.40	31.1-42.4

SKELETAL INDICES

Dental age I

	NUMBER	MEAN	RANGE
Brachial	3	82.5	80.8-83.8
Crural	4	81.2	80.1-83.5
Intermembral	3	116.5	111.0-121.5
Humeral	4	24.8	22.9-26.8
Radial	3	19.2	18.7-20.0
Femoral	4	31.1	27.2-32.6
Tibial	4	28.5	27.2-29.2
Pelvic inlet	3	62.6	51.7-70.4
Scapular	1	83.6	.....
Claviculo-humeral	4	38.4	36.2-39.3

Female dental age II

Brachial	4	81.2	77.9-83.7
Crural	4	82.3	78.8-86.0
Intermembral	4	115.0	113.1-119.2
Humeral	5	24.1	22.2-27.5
Radial	4	17.8	16.0-21.5
Femoral	4	28.6	24.8-32.2
Tibial	5	25.6	22.9-29.6
Pelvic inlet	1	53.8	.....
Scapular	3	82.0	75.5-89.4
Claviculo-humeral	4	37.3	33.4-40.0

Female dental age III

Brachial	2	80.0	79.0-81.0
Crural	2	79.8	79.7-80.0
Intermembral	2	116.8	116.4-117.2
Humeral	2	20.4	20.0-20.9
Radial	2	15.0	14.6-15.5
Femoral	2	26.6	25.8-27.7
Tibial	2	25.4	24.7-26.2
Pelvic inlet	3	59.3	57.2-60.7
Scapular	1	92.8	.....
Claviculo-humeral	2	36.6	35.9-37.4

SKELETAL INDICES

Female dental age IV

	NUMBER	MEAN	RANGE
Brachial	8	80.3	76.5-84.3
Crural	9	79.7	77.5-83.8
Intermembral	7	116.3	112.9-121.0
Humeral	9	22.3	19.9-28.8
Radial	8	16.5	14.8-18.7
Femoral	10	28.6	23.8-30.2
Tibial	9	26.6	25.4-30.9
Pelvic inlet	6	64.4	57.8-71.4
Scapular	6	76.1	72.5-80.7
Claviculo-humeral	9	33.7	30.6-36.7

Female dental age V

Brachial	11	81.0	76.5-86.0
Crural	11	82.3	79.0-85.2
Intermembral	11	118.4	114.8-122.5
Humeral	11	23.7	19.6-23.8
Radial	11	16.1	14.3-17.4
Femoral	11	26.6	26.0-31.2
Tibial	11	24.9	22.8-27.3
Pelvic inlet	11	66.6	57.6-74.6
Scapular	9	79.0	72.3-92.6
Claviculo-humeral	10	35.7	34.1-38.7

Female dental age VI

	NUMBER	MEAN	S. D.	S. E.	C. V.	RANGE
Brachial	35	80.16	2.54	0.43	3.18	75.1-85.5
Crural	37	81.24	2.03	0.33	2.50	77.4-85.8
Intermembral	35	118.38	2.54	0.43	2.14	112.6-124.2
Humeral	35	23.36	2.24	0.38	9.60	19.9-28.8
Radial	36	17.42	1.64	0.28	9.43	13.7-21.0
Femoral	37	30.56	2.79	0.46	9.15	25.9-35.2
Tibial	36	26.98	1.92	0.32	7.12	21.7-31.0
Pelvic inlet	32	71.67	5.80	1.02	8.10	57.4-82.4
Scapular	35	77.85	6.30	1.06	8.11	68.5-94.4
Claviculo-humeral	28	37.27	1.90	0.36	5.10	33.0-40.6

Septal aperture of humerus

It appears that there may be some slight tendency to close some of the apertures which appear at early ages. It is also possible that the adult females show a somewhat higher frequency, especially in the bilateral appearances. Data by Schultz (1937) show that approximately the same frequencies appeared in a larger series of 81 males and 50 females. His data show that 34.5 per cent of males, and 64 per cent of females show apertures in some degree, on adult individuals.

	Right (per cent)	*Both (per cent)*	*Left (per cent)*	*Total (per cent)*	*Right (per cent)*	*Both (per cent)*	*Left (per cent)*	*Total (per cent)*
	Male VI				*Female VI*			
				58 skeletons				28 skeletons
+	6.9	8.6	5.2	20.7	...	3.6	32.1	3.6	39.3	...
++	...	10.3	...	10.3	31.0	...	14.3	...	14.3	53.6
O	...	...	...	...	69.0	...	...	...	...	46.4
	Male V				*Female V*			
				34 skeletons				16 skeletons
+	11.8	23.5	2.9	37.2	...	6.2	12.5	6.2	24.9	...
++	...	38.3	...	38.3	75.5	...	31.3	...	31.3	56.2
O	...	...	...	...	24.5	...	...	...	...	43.8
	Male IV				*Female IV*			
				10 skeletons				9 skeletons
+	...	...	...	...	...	22.2	22.2	...	44.4	...
++	...	70.0	...	70.0	70.0	11.1	11.1	...	22.2	66.6
O	...	...	...	...	30.0	...	...	...	...	33.4
	Male III				*Female III*			
				10 skeletons				3 skeletons
+	...	30.0	...	30.0	...	...	33.3	...	33.3	...
++	...	50.0	...	50.0	80.0	...	...	...	...	33.3
O	...	...	...	...	20.0	...	...	...	...	66.7
	Male II				*Female II*			
				9 skeletons				5 skeletons
+	...	33.3	...	33.3	...	...	...	...	...	...
++	...	22.2	...	22.2	55.5	...	...	60.0	60.0	60.0
O	...	...	...	...	44.5	...	...	...	...	40.0

Type values of skeletal characters for the groups B and L

	NUMBER	MEAN	S. D.	S. E.	C. V.	RANGE
			Clavicle length			
B	24	165.6	9.40	1.92	5.68	142-181
L	10	173.5	...	...	...	153-190
			Mean humerus length			
B	28	439.3	20.80	3.93	4.74	405-486
L	16	437.5	26.60	6.65	6.08	398-486
			Mean radius length			
B	29	350.5	14.00	2.60	4.00	322-377
L	17	352.6	22.88	5.55	6.50	312-393
			Mean femur length			
B	29	374.0	18.35	3.41	4.91	338-406
L	17	377.3	19.62	4.77	5.21	334-411
			Mean tibia length			
B	29	298.4	14.72	2.74	4.94	270-339
L	16	301.9	19.36	4.84	6.41	273-340
			Brachial index			
B	28	80.2	1.94	0.37	2.42	74.6-83.3
L	16	80.7	2.42	0.60	3.00	75.9-84.0
			Crural index			
B	29	80.1	2.60	0.48	3.25	74.4-86.6
L	16	79.1	2.46	0.61	3.11	75.0-83.9
			Intermembral index			
B	28	117.6	2.88	0.54	2.45	112.4-123.2
L	16	117.3	2.99	0.60	2.52	113.4-124.5
			Claviculo-humeral index			
B	23	38.1	2.83	0.59	7.43	31.1-42.4
L	10	39.7	...	...	...	35.4-41.1
			Scapular length			
B	29	173.6	6.56	1.24	3.84	159-181
L	14	174.0	...	...	...	158-183

Type values of skeletal characters for the groups B and L

	NUMBER	MEAN	S. D.	S. E.	C. V.	RANGE
			Upper fossa			
B	29	92.7	5.72	1.06	6.18	83-108
L	14	95.9	...	...	...	81-110
			Lower fossa			
B	29	143.3	12.56	2.34	8.76	116-162
L	14	146.9	...	...	...	112-171
			Maximum pelvic breadth			
B	26	415.8	20.00	3.93	4.81	380-453
L	14	405.4	...	...	...	378-449

Mean values of certain traits

	B	*L*
Humerus plus radius	789.8	790.1
Femur plus tibia	672.4	679.4
Scapular index	73.5	71.6

Asymmetries in long bones

(All ages combined)

	Male	*Per cent*			*Female*	*Per cent*		
	No. Skel.	R > L	R = L	R < L	No. Skel.	R > L	R = L	R < L
Humerus	96	37.5	15.6	47.0	49	28.4	8.2	63.4
Radius	98	37.8	12.3	50.0	53	43.4	13.2	43.4
Humerus + radius	84	34.6	9.5	56.0	44	25.0	20.4	54.6
Femur	106	48.1	16.0	35.8	60	45.0	26.7	28.3
Tibia	81	71.6	11.1	17.3	57	77.2	8.8	14.0
Femur + tibia	94	77.7	5.3	17.0	57	70.2	8.8	21.0
Total of combined sexes								
Humerus	149	34.2	12.8	53.0				
Radius	153	39.2	13.2	47.6				
Humerus + radius	130	30.7	13.8	55.5				
Femur	170	47.6	19.4	33.0				
Tibia	142	72.5	9.9	17.6				
Femur + tibia	155	74.4	6.9	18.7				

PATHOLOGICAL CONDITIONS

A study of the frequencies of fractures and various indications of other pathological conditions in the skeleton is apt to produce a misleading conclusion. This is due to the fact that the very possession of such conditions may render animals more likely to be met and killed by the hunter. Many other unknown factors of animal behavior may enter this problem. It must be kept in mind, then, that the following discussion applies only to a museum collection and not necessarily to a native population.

Fractures were tabulated for both skulls and skeletons. In every case, they showed signs of healing or were not counted. Unhealed fractures were considered to be incidental to the actual killing of the individuals. This may not always have been true, but there is no way of correcting for this possibility.

Usually fractures were unilateral, except in one case of broken zygomatic arches, and five cases of broken nasal bones. Also, all cases encountered were confined to dental Stages V and VI. This is an interesting point, leading one to wonder whether the youngsters are so agile as to escape completely the dangers of living as manifested in broken bones, or whether they are less likely to recover from accidents than are adults.

In all, fifteen skulls and eleven skeletons showed healed fractures, with no one individual possessing damages to both skull and skeleton. Thus, a total of twenty-six such individuals was encountered. This frequency produced 3.3 per cent of skulls and 5.6 per cent of skeletons. Eight males and three females had skeletal fractures, and twelve males and three females had skull fractures. These different fractures, listed by total fracture rather than by individuals, follow in tabular form.

Frequencies of positions of fracture

Humerus	2
Radius	1
Ribs	4
Femur	2
Tibia	3
Fibula	3
Zygomatic arches	6
Nasal bones	7
Supra-orbital crest	3
Orbital rim	1
Maxilla and premaxilla	1

These values show interesting contrasts with data listed by Schultz (1941) for the orang-utan. His data show higher frequencies and many among younger individuals. This difference is probably due to the marked difference in habitat and behavior, the orang-utan dwelling so much in trees and the gorilla so much on the ground.

Many other bony deformations were encountered which may be mentioned:

(1) Bony exostoses appeared on the zygomatic bones of 6 skulls and on the supra-orbital crests of three. Some growth appeared on the left maxilla of one and on an orbital rim of another. Exostoses appeared also on one scapula, two humeri, and two radii. In seven cases, small intervertebral nodules of bone lay in the intervertebral discs and on the centra themselves; all occurred in individuals of Stages V and VI.

(2) Degenerative appearances of bone occurred on two zygomatic bones, one nasal cavity with the conchae involved, one orbital floor, one palate, six maxillae and maxillary sinuses, one nasal floor, one mastoid process, two occipital condyles, two temporomandibular joints, two interorbital regions, one humerus, two radii, one ulna, one femur, three tibiae, one fibula, and three vertebral areas. All of these were found on Stage-V and -VI individuals, except one of the diseased radii was on a Stage-III male. Degenerative bone diseases, then, appear to occur among aged individuals more than among youngsters.

(3) One skull, a male V, and two femora, one female II, and one male V, had bullets embedded in them, with healing of the injuries showing that gorillas do not always succumb to direct attacks.

(4) Atrophic (?) perforations were found in ten orbits, one palate, one pair of frontal sinuses, five scapulae, and four ilia.

(5) Indications of arthritis, other than ones mentioned above, were encountered ten times in vertebrae, twice in the radius and ulna, three times in the tibia and fibula, and twice in the femur.

(6) The atlas was fused to the occipital condyles in one case, and vertebral spines and transverse processes were found fused in various degrees five times. The last rib was fused with the vertebra in two cases.

CONCLUSIONS

Eighteen metric and three indicial traits of 456 skulls of *Gorilla gorilla* have been treated as separate and distinct growth regions. It now remains to consider what conclusions may be drawn from this composite picture.

Unfortunately, growth cannot be studied in terms of absolute time in *Gorilla gorilla* as yet, but must be treated entirely upon a rather rough basis of assessed stages in the growth processes. For the purpose of this study, six stages were utilized. These have been previously defined.

Skull growth may be divided into two categories: one, that of the brain-case; and two, that of the face. The basic structure of the brain-case is prepared by the time of the completion of the deciduous dentition. From this period until adulthood has been reached, almost all brain-case growth is due to secondary deposition of bone to form the crests and the mastoid processes. The male skull gains in cranial capacity throughout the entire growth period, while the female skull attains its maximum by the time of the eruption of the second permanent molar. The orbital capacity, which is correlated with both the growth of the brain-case and of the face, due to the fact that the increase in the orbit is due to anterior and superior deposition of bone upon the basic orbital structure, follows much the same pattern as does the cranial capacity. The male increases during the entire period, while the female ceases at the time of the appearance of the third permanent molar.

In the male skulls, growth during the first three dental age stages is predominantly lateral, due to mastoid expansion, followed by an increasingly predominant longitudinal growth, due to crest expansion. The female skulls show only a moderate lateral growth throughout the first five stages and a more marked longitudinal growth during the last stage.

The index of the brain-case, itself, maintains a much more constant decrease, indicating a gradual lengthening of the structure relative to its breadth. This is due mostly to external growth, rather than to any endocranial change.

Facial growth is a much more exuberant phenomenon. The face grows anteriorly in the male throughout the growth period, while in the female it stops at Stage III. The hafting region is somewhat different. The basion-nasion distance increases in the male until Stage V, but reaches much of its size in the female by Stage III.

Lateral facial growth, as shown by biorbital and bizygomatic breadths continues throughout the whole period in the male, but again ceases in the female by Stage III.

Vertical facial growth occurs in both sexes in the lower age stages, with only a small amount in the later ones.

The entire set of traits studied on the skulls indicates that both sexes are relatively stable and correlated until the second permanent molar erupts. At this time, the male enters a phase which produces a tremendous divergence and establishes a pattern quite different from that of the female.

Sutures of the gorilla skull close in the following order: internasal, sutures between lateral and squamous occipitals, sutures between basi- and lateral occipitals, lambdoid, sagittal, palatal, coronal, intermaxillary, and basilar sutures. Some variations in this order may occur. During Stage III, a high frequency of overbite occurs. This lasts somewhat into Stage IV. It appears to be due to the growth of both the facial region and the incisors.

The significance of the bimodality of the distribution curves of the cranial index of the skulls has been fully discussed previously.

Many metric and ten indicial traits of 199 skeletons were studied.

The number of vertebrae ranges from 31 to 35, with an average of 32.2 in the males and 32.3 in the females. There are always seven cervical vertebrae. The thoracic vertebrae range from 12 to 14, with an average of 13.0 in both sexes. The lumbar vertebrae range from 2 to 4, with an average of 3.7 in both sexes. The sacral vertebrae range from 5 to 7, with an average of 5.5 in the males and 5.4 in the females, and the coccygeals range from 2 to 5, with an average of 3.3 in the males and 3.5 in the females.

The sternum is formed normally of the manubrium and four segments, but this number may vary due to separate centers of ossification. Sternal ribs vary from 6 to 8, with 93.4 per cent of the males having 7, and 84.6 per cent of the females having 7. Of the females 21.1 per cent have 6.

Growth in the scapula follows the usual pattern already established. Both sexes grow at approximately the same rates until Stage IV, when the male diverges from the female. Morphological length gains at the expense of the physiological length.

The long bones all show the same pattern, with the male again gaining disproportionately over the female following Stage IV. Middle

circumferences remain in the same proportion to the lengths throughout the entire growth period.

In the pelvis, growth is again mainly quantitative rather than qualitative, with the pelvic inlet index remaining approximately the same in both sexes.

In final summary, metric data on the skull and skeleton of *Gorilla gorilla* indicate that small sex dimorphism exists until the second permanent molar appears, then a marked divergence appears, due to exuberant growth on the part of the male.

Editorial note: Owing to service in the army, Dr. Randall has been unable to edit the final draft of the above paper or to read it in galley proof.

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APPENDIX A

AGE STAGE REDUCTIONS FOR METRIC CORRELATION WITH SCHULTZ DATA

Male juvenile Stage II

(Krogman III-IV)

	NUMBER	MEAN	S. D.	S. E.	C. V.	RANGE
Cranial capacity	42	513.2	50.95	7.85	9.93	410-635
Orbital capacity	33	30.5	5.52	0.96	18.11	20-42
Maximum length	47	160.9	17.68	2.14	9.16	138-204
Cranial length	46	149.6	9.00	1.33	6.01	131-174
Inion-prosthion	48	237.0	22.62	3.28	9.55	207-300
Basion-prosthion	43	162.3	16.70	2.54	10.28	125-196
Basion-nasion	43	113.3	9.64	1.47	8.50	99-138
Maximum breadth to suture	48	103.5	4.45	0.64	4.30	96-112
Total maximum breadth	48	136.8	11.35	1.64	8.31	118-164
Postorbital breadth	48	72.5	3.84	0.55	5.30	64-86
Biorbital breadth	48	121.1	13.32	1.93	11.00	100-161
Interorbital breadth	48	23.3	4.92	0.71	21.10	16-36
Bizygomatic breadth	48	145.9	13.92	2.01	9.58	123-184
Total skull height	43	97.4	8.82	1.34	9.08	87-129
Cranial height	42	95.8	4.75	0.73	4.96	87-110
Facial height	48	101.5	8.96	1.29	8.83	80-126
Palate length	48	92.3	9.70	1.40	10.50	70-117
Palate breadth	48	67.8	5.00	0.72	7.48	60-81
Cranial index	47	85.6	4.27	0.62	4.99	78.5-100.0
Upper facial index	48	143.9	10.12	1.47	7.05	129.2-169.5
Palatal index	48	74.0	4.90	0.71	6.61	64.1-88.8

Male adult
(Krogman V-VI)

	NUMBER	MEAN	S. D.	S. E.	C. V.	RANGE
Cranial capacity	133	543.0	50.00	4.34	9.23	420-685
Orbital capacity	180	40.7	4.51	0.34	11.09	27-54
Maximum length	207	193.2	10.70	0.74	5.55	158-228
Cranial length	197	163.0	7.46	0.53	4.58	143-183
Inion-prosthion	207	292.2	18.22	1.27	6.24	240-332
Basion-prosthion	171	196.6	11.05	0.85	5.63	169-221
Basion-nasion	172	133.1	6.65	0.51	5.00	118-153
Maximum breadth to suture	206	101.5	4.54	0.32	4.46	84-117
Total maximum breadth	199	158.0	9.74	0.69	6.16	132-182
Postorbital breadth	209	71.5	3.89	0.27	5.45	59-80
Biorbital breadth	207	148.2	5.96	0.42	4.01	127-168
Interorbital breadth	208	31.5	4.06	0.28	12.90	21-46
Bizygomatic breadth	195	176.6	8.92	0.64	5.05	148-200
Total skull height	168	121.0	11.89	0.92	9.82	94-150
Cranial height	168	99.3	5.21	0.40	5.26	86-116
Facial height	212	119.1	8.51	0.58	7.14	91-141
Palate length	204	110.0	6.89	0.48	6.26	93-126
Palate breadth	199	77.0	4.40	0.31	5.72	65-88
Cranial index	195	81.5	5.65	0.40	6.94	69.3-98.2
Upper facial index	194	149.0	11.54	0.83	7.75	125.6-189.1
Palatal index	192	70.2	3.58	0.26	5.10	61.6-89.7

Female juvenile Stage II
(Krogman III-IV)

	NUMBER	MEAN	S. D.	S. E.	C. V.	RANGE
Cranial capacity	16	466.0	41.51	10.38	8.94	410.545
Orbital capacity	14	27.4	....	....	....	22-36
Maximum length	23	150.1	7.98	1.66	5.31	131-163
Cranial length	23	142.0	....	....	....	130-154
Inion-prosthion	23	212.2	12.55	2.62	5.90	183-229
Basion-prosthion	17	147.0	9.55	2.31	8.96	125-160
Basion-nasion	16	106.4	5.84	1.46	5.48	94-116
Maximum breadth to suture	23	98.5	4.78	1.00	4.85	87-108
Total maximum breadth	22	124.4	7.52	1.62	6.05	111-140
Postorbital breadth	23	70.5	4.12	0.86	5.85	63-82
Biorbital breadth	22	112.4	7.19	1.53	6.38	101-125
Interorbital breadth	22	20.4	3.01	0.63	1.48	16-27
Bizygomatic breadth	21	134.8	6.64	1.44	7.92	121-149
Total skull height	17	93.2	4.14	1.00	4.44	84-99
Cranial height	17	....	....	....	....	84-99
Facial height	22	91.4	7.17	1.53	7.86	77-104
Palate length	23	80.8	6.59	1.37	8.15	67-90
Palate breadth	23	63.3	2.94	0.61	4.65	58-68
Cranial index	22	81.2	3.77	0.80	4.65	74.4-89.4
Upper facial index	20	150.6	10.00	2.24	6.65	133.5-171.5
Palatal index	23	78.6	4.43	0.92	6.64	69.0-91.1

Female adult
(Krogman V-VI)

	NUMBER	MEAN	S. D.	S. E.	C. V.	RANGE
Cranial capacity	78	461.0	47.70	5.40	10.34	340-580
Orbital capacity	112	31.3	3.80	0.36	12.13	25-45
Maximum length	117	156.2	7.15	0.66	4.57	140-178
Cranial length	114	145.2	6.02	0.56	4.14	131-162
Inion-prosthion	118	228.0	8.59	0.79	3.76	207-261
Basion-prosthion	93	157.3	7.40	0.46	2.80	141-175
Basion-nasion	93	112.5	4.96	0.52	4.41	103-125
Maximum breadth to suture	117	98.9	5.62	0.52	5.70	87-109
Total maximum breadth	119	131.2	6.16	0.56	4.69	115-147
Postorbital breadth	121	69.1	3.62	0.33	5.24	61-79
Biorbital breadth	118	122.1	5.32	0.49	4.35	108-136
Interorbital breadth	121	23.4	3.69	0.34	15.77	15-35
Bizygomatic breadth	113	145.6	6.20	0.58	4.26	132-160
Total skull height	91	94.3	4.39	0.46	4.66	84-106
Cranial height	90	94.3	4.70	0.50	4.98	83-110
Facial height	123	99.0	6.06	0.55	6.13	82-113
Palate length	120	89.8	4.64	0.42	5.16	78-104
Palate breadth	120	68.0	3.52	0.32	5.18	59-79
Cranial index	116	84.2	7.06	0.38	4.83	73.6-95.1
Upper facial index	113	148.0	10.31	0.97	6.99	122.0-190.9
Palatal index	117	76.2	3.83	0.35	5.03	66.6-90.7

Male juvenile, Stage II
(Krogman III-IV)

	NUMBER	MEAN	S. D.	S. E.	C. V.	RANGE
Right humerus	16	361.3	37.40	9.35	10.33	306-427
Left humerus	17	364.0	39.90	9.69	10.96	289-425
Right radius	15	300.0	31.18	8.04	10.39	244-338
Left radius	16	288.5	31.59	7.90	10.54	225-332
Right humerus + radius	14	655.3	....	....	....	550-748
Left humerus + radius	16	639.5	71.10	17.78	11.12	514-750
Right femur	18	312.0	38.81	9.14	12.45	239-361
Left femur	18	317.6	34.63	8.16	10.91	257-360
Right tibia	19	250.0	39.90	9.15	15.96	191-288
Left tibia	18	248.7	28.63	6.75	11.50	186-287
Right femur + tibia	18	562.5	68.92	16.19	12.22	430-644
Left femur + tibia	17	571.0	61.58	14.93	10.79	468-647
Circumferences						
a. Humerus	19	81.4	8.91	2.04	10.94	62-94
b. Radius	20	48.6	5.97	1.33	12.27	35-60
c. Ulna	19	54.0	6.72	1.54	12.42	40-66
d. Femur	20	88.9	8.90	1.99	10.01	65-107
e. Tibia	20	67.2	7.19	1.60	10.69	50-81
f. Fibula	20	34.6	3.62	0.81	10.46	25-40
Breadth vertebra						
a. T_7	18	29.6	3.91	0.92	13.21	24-38
b. L_2	20	38.3	4.68	1.05	12.20	30-48
Sternum						
a. Manubrium length	19	56.4	7.69	1.76	13.61	77-78
b. Corpus length	13	92.5	....	....	....	72-109
c. Sternum length	13	145.0	....	....	....	117-170
d. Manubrium breadth	19	66.1	8.74	2.00	13.21	48-82
e. Corpus breadth	13	39.3	....	....	....	27-52
Scapula						
a. Length	19	126.5	16.35	3.75	12.91	94-154
b. Upper breadth	12	64.2	....	....	....	54-90
c. Lower breadth	13	99.0	....	....	....	77-135
Pelvis						
a. Iliac length	9	178.2	....	....	....	155-230
b. Ischial length	17	104.4	16.75	4.06	16.01	75-135
c. Pubic length	17	89.9	13.50	3.28	15.03	64-112
d. Iliac breadth	13	158.0	....	....	....	126-212
e. Iliac fossa	13	123.0	....	....	....	102-168
f. Sacral surface	13	32.6	....	....	....	27-37
g. Maximum breadth	9	313.0	....	....	....	250-418
h. Inlet breadth	12	108.2	....	....	....	88-137
i. Prom-symphysion	10	166.4	....	....	....	132-202
j. Prom-crest	6	74.0	....	....	....	60-98
Clavicle length	20	128.8	14.59	3.26	11.61	108-159
Patellar breadth	12	33.8	....	....	....	31-41
Skeletal age	10	13.1	....	....	....	11.1-15.40

Male adult
(Krogman V-VI)

	NUMBER	MEAN	S. D.	S. E.	C. V.	RANGE
Right humerus	84	435.6	23.59	2.57	5.41	389-496
Left humerus	78	436.3	23.40	2.65	5.36	388-492
Right radius	86	350.0	17.68	1.91	5.05	309-392
Left radius	81	351.4	18.00	2.00	5.13	311-395
Right humerus + radius	81	785.8	40.00	4.44	5.09	700-878
Left humerus + radius	72	789.8	40.32	4.75	5.11	700-879
Right femur	85	375.0	20.68	2.24	5.52	317-424
Left femur	86	374.2	20.83	2.25	5.58	319-422
Right tibia	81	302.3	18.69	2.07	6.18	266-342
Left tibia	82	298.0	15.68	1.73	5.26	262-337
Right femur + tibia	77	675.8	34.21	3.91	5.06	583-753
Left femur + tibia	80	672.4	22.19	2.48	3.30	581-755
Circumferences						
a. Humerus	87	105.5	7.07	0.76	6.61	83-122
b. Radius	89	63.1	4.48	0.53	7.10	51-74
c. Ulna	88	69.5	5.49	0.58	7.90	56-90
d. Femur	89	113.6	6.96	0.74	6.12	92-130
e. Tibia	88	83.0	6.18	0.66	7.45	69-102
f. Fibula	88	43.0	3.54	0.38	8.25	34-52
Breadth vertebra						
a. T7	84	35.0	3.36	0.37	9.61	27-42
b. L2	84	43.8	3.54	0.39	8.08	34-52
Sternum						
a. Manubrium length	66	74.8	9.53	1.17	10.06	47-95
b. Corpus length	24	131.2	12.29	2.53	9.47	106-154
c. Sternum length	28	205.8	18.81	3.55	9.16	166-241
d. Manubrium breadth	80	94.0	12.01	1.35	12.79	61-122
e. Corpus breadth	53	54.5	8.10	1.11	14.87	29-73
Scapula						
a. Length	81	168.7	9.61	1.07	5.70	132-193
b. Upper breadth	72	93.6	12.10	1.43	12.92	76-110
c. Lower breadth	73	140.2	13.74	1,61	9.79	109-171
Pelvis						
a. Iliac length	75	235.9	11.12	1.29	4.73	208-263
b. Ischial length	74	127.0	7.70	0.90	6.06	93-144
c. Pubic length	80	116.8	8.86	0.99	7.59	94-136
d. Iliac breadth	80	212.0	12.39	1.39	5.85	182-241
e. Iliac fossa	79	166.0	10.11	1.14	6.10	138-188
f. Sacral surface	79	39.4	3.64	0.41	9.25	31-51
g. Maximum breadth	72	407.2	22.60	2.66	5.55	341-453
h. Inlet breadth	81	136.1	10.89	1.21	8.05	116-166
i. Prom-symphysion	81	196.6	14.92	1.66	7.60	160-250
j. Prom-crest	62	103.0	10.48	1.33	10.18	81-132
Clavicle length	71	163.2	10.81	1.28	6.63	130-190
Patellar breadth	66	42.0	4.03	0.50	9.60	30-51

Female juvenile Stage II
(Krogman III-IV)

	NUMBER	MEAN	RANGE
Right humerus	11	334.0	217-369
Left humerus	8	349.9	305-371
Right radius	10	272.8	245-297
Left radius	8	272.5	244-298
Right humerus + radius	10	614.4	553-656
Left humerus + radius	7	625.1	623-669
Right femur	12	291.5	247-314
Left femur	11	289.7	247-313
Right tibia	10	233.4	191-263
Left tibia	11	232.0	194-257
Right femur + tibia	11	546.0	438-574
Left femur + tibia	10	521.9	441-567
Circumferences			
a. Humerus	12	75.0	61-92
b. Radius	12	45.5	36-63
c. Ulna	12	51.4	42-69
d. Femur	12	74.9	65-94
e. Tibia	12	60.9	52-76
f. Fibula	12	31.9	26-40
Breadth vertebra			
a. T7	13	26.1	22-30
b. L2	13	33.2	27-38
Sternum			
a. Manubrium length	12	52.2	37-60
b. Corpus length	9	91.4	74-108
c. Sternum length	9	143.8	115-162
d. Manubrium breadth	12	60.1	43-79
e. Corpus breadth	9	37.1	25-42
Scapula			
a. Length	10	123.4	100-136
b. Upper breadth	7	64.0	53-70
c. Lower breadth	8	95.2	70-104
Pelvis			
a. Iliac length	7	184.0	158-211
b. Ischial length	9	89.0	69-98
c. Pubic length	10	85.8	63-99
d. Iliac breadth	7	159.9	130-184
e. Iliac fossa	7	119.9	92-139
f. Sacral surface	10	30.5	25-37
g. Maximum breadth	7	302.3	257-338
h. Inlet breadth	9	104.6	82-124
i. Prom-symphysion	9	166.8	135-192
j. Prom-crest	2	71.5	65-78
Clavicle length	12	116.3	102-131
Patellar breadth	8	30.2	26-37
Skeletal age	8	12.4	8.1-14.4

Female adult
(Krogman V-VI)

	NUMBER	MEAN	S. D.	S. E.	C. V.	RANGE
Right humerus	43	363.7	16.30	2.48	4.49	329-397
Left humerus	43	363.1	15.69	2.39	4.32	330-399
Right radius	43	291.5	11.52	1.56	3.96	268-315
Left radius	46	292.3	12.70	1.87	4.35	264-314
Right humerus + radius	40	657.0	24.63	3.90	3.86	592-712
Left humerus + radius	42	655.9	27.10	4.18	4.13	594-712
Right femur	47	304.9	10.50	1.54	3.45	284-333
Left femur	48	306.0	11.50	1.66	3.86	284-331
Right tibia	46	250.1	12.21	1.80	4.89	226-286
Left tibia	47	246.8	11.21	1.64	4.55	223-279
Right femur + tibia	46	554.7	19.30	2.85	3.49	510-619
Left femur + tibia	47	552.5	19.71	2.88	3.57	506-610
Circumferences						
a. Humerus	47	83.8	6.30	0.92	7.52	72-98
b. Radius	47	49.8	4.10	0.60	8.24	40-60
c. Ulna	46	54.2	4.21	0.62	7.78	47-63
d. Femur	48	92.3	7.20	1.04	7.80	77-112
e. Tibia	47	66.1	4.81	0.70	7.28	58-81
f. Fibula	48	36.5	2.78	0.41	7.62	28-41
Breadth vertebra						
a. T7	47	27.1	2.28	0.33	8.42	22-31
b. L2	47	34.3	3.08	0.45	8.99	29-45
Sternum						
a. Manubrium length	35	58.9	4.98	0.84	8.46	48-71
b. Corpus length	10	100.2	....	....	....	80-126
c. Sternum length	13	158.7	....	....	....	132-191
d. Manubrium breadth	41	169.9	7.76	1.21	11.10	56-92
e. Corpus breadth	23	41.4	5.23	1.09	12.62	32-50
Scapula						
a. Length	45	131.1	6.00	0.89	4.57	119-147
b. Upper breadth	44	68.0	4.85	0.73	7.14	61-80
c. Lower breadth	44	100.1	9.31	1.40	9.30	75-116
Pelvis						
a. Iliac length	44	196.8	8.69	1.31	4.41	181-221
b. Ischial length	45	198.3	4.91	0.73	5.00	89-111
c. Pubic length	45	96.2	6.95	1.03	7.22	82-107
d. Iliac breadth	45	173.2	11.20	1.67	6.48	152-195
e. Iliac fossa	45	135.9	8.41	1.25	6.20	114-149
f. Sacral surface	43	31.8	3.68	0.56	11.58	25-41
g. Maximum breadth	43	335.0	18.02	2.75	5.39	296-376
h. Inlet breadth	45	123.0	8.54	1.27	6.94	103-150
i. Prom-symphysion	44	175.2	15.91	2.40	9.09	134-211
j. Prom-crest	37	76.7	9.28	1.52	12.10	63-97
Clavicle length	39	134.3	7.57	1.21	5.62	116-151
Patellar breadth	38	32.0	2.70	0.44	8.45	26-37

SKELETAL INDICES

Female juvenile Stage II
(Krogman III-IV)

	NUMBER	MEAN	RANGE
Brachial	10	80.2	76.5-84.3
Crural	11	79.7	77.5-83.8
Intermembral	9	116.4	112.9-121.0
Humeral	11	21.9	19.9-25.8
Radial	10	16.2	14.6-18.7
Femoral	12	28.2	23.8-30.2
Tibial	11	26.4	24.7-30.9
Pelvic inlet	9	62.7	57.2-71.4
Claviculo-humeral	11	34.2	30.6-37.4

Female adult
(Krogman V-VI)

	NUMBER	MEAN	S. D.	S. E.	C. V.	RANGE
Brachial	46	80.4	2.63	0.39	3.28	75.1-86.0
Crural	48	81.5	2.14	0.31	2.63	77.4-85.8
Intermembral	46	118.3	2.48	0.37	2.09	112.6-124.2
Humeral	46	23.1	2.09	0.31	9.05	19.6-28.8
Radial	47	17.0	1.56	0.23	9.18	13.7-21.0
Femoral	48	30.1	2.69	0.39	8.95	25.9-35.2
Tibial	47	26.7	2.03	0.30	7.61	21.7-31.0
Pelvic inlet	43	70.7	6.05	0.92	8.61	57.4-82.4
Scapular	44	78.2	6.76	1.02	8.65	68.5-94.4
Claviculo-humeral	38	36.8	1.92	0.31	5.22	33.0-40.6

SKELETAL INDICES

Male juvenile Stage II
(Krogman III-IV)

	NUMBER	MEAN	S. D.	S. E.	C. V.	RANGE
Brachial	18	80.4	1.95	0.46	2.43	75.8-83.0
Crural	19	79.9	1.94	0.44	2.43	76.8-85.3
Intermembral	18	116.2	1.84	0.43	1.14	112.5-119.2
Humeral	18	22.2	1.78	0.42	8.02	20.0-25.9
Radial	19	16.7	1.19	0.27	7.14	15.0-18.8
Femoral	19	28.7	1.57	0.36	5.48	26.8-31.7
Tibial	19	27.1	1.35	0.31	4.99	24.8-29.0
Pelvic inlet	10	66.6	....	....	....	58.3-76.5
Scapular	12	76.9	....	....	....	68.5-86.0
Claviculo-humeral	17	36.3	1.91	0.46	5.27	33.4-40.0

Male adult
(Krogman V-VI)

	NUMBER	MEAN	S. D.	S. E.	C. V.	RANGE
Brachial	86	80.4	1.87	0.20	2.33	74.6-85.1
Crural	87	80.3	2.23	0.24	2.78	74.4-86.6
Intermembral	83	116.8	2.90	0.32	2.48	110.9-124.5
Humeral	86	24.3	1.85	0.20	7.62	20.1-28.8
Radial	87	18.1	1.34	0.14	7.40	15.1-22.2
Femoral	89	30.5	2.06	0.22	6.75	25.6-38.0
Tibial	87	28.4	2.00	0.21	7.05	23.6-33.6
Pelvic inlet	79	70.0	6.82	0.77	9.75	54.9-89.5
Scapular	72	72.8	4.96	0.58	6.82	62.9-86.2
Claviculo-humeral	68	37.6	2.56	0.31	6.82	31.1-42.4

RECENT LITERATURE

USEFUL IN THE STUDY OF HUMAN BIOLOGY

In this department will be noticed the books and reprints which are currently received at the Editorial Office. Publications intended for notice here should be addressed to Dr. Lowell J. Reed, Editor of HUMAN BIOLOGY, 615 North Wolfe Street, Baltimore—5, Maryland, U. S. A.

I. EVOLUTION AND GENETICS

1. *Evolution — General Principles*

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